

The Chemical Age

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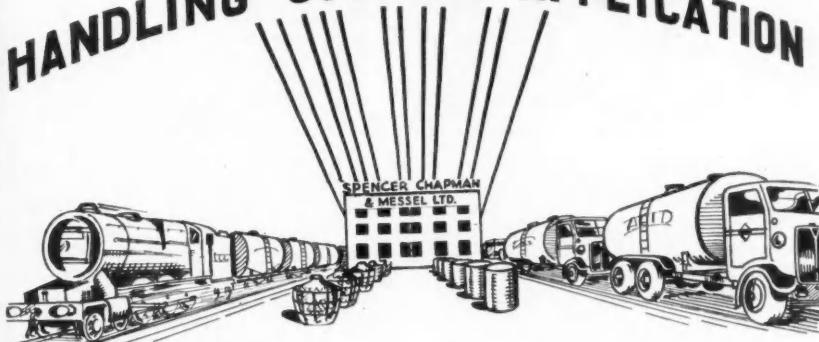
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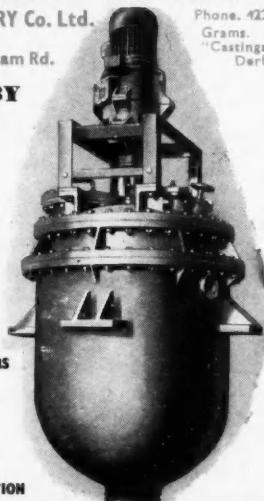
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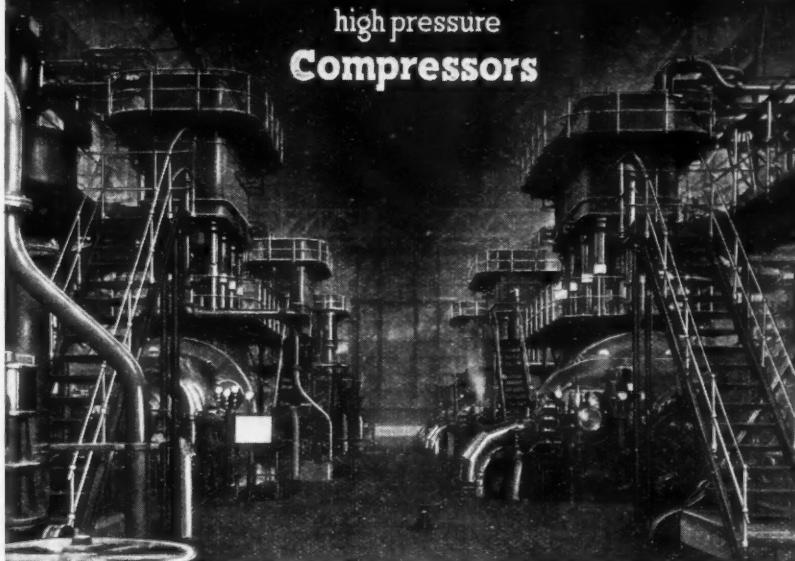
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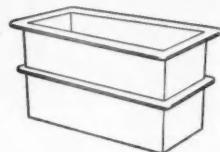
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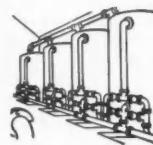
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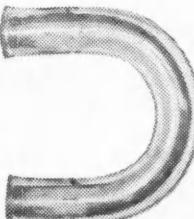
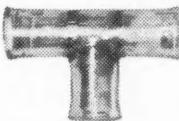
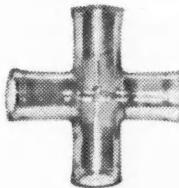
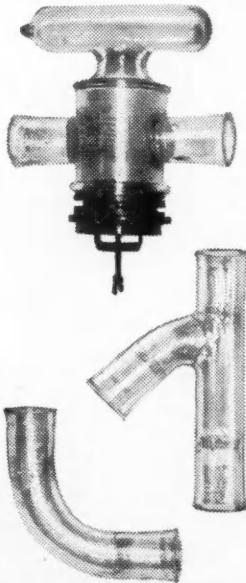
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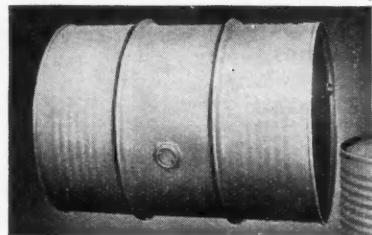
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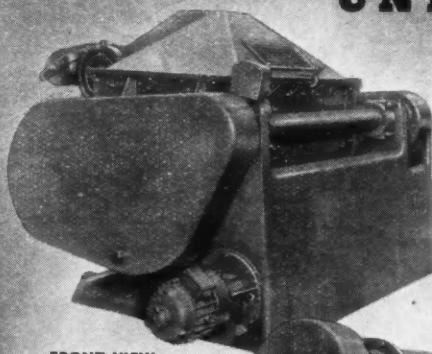
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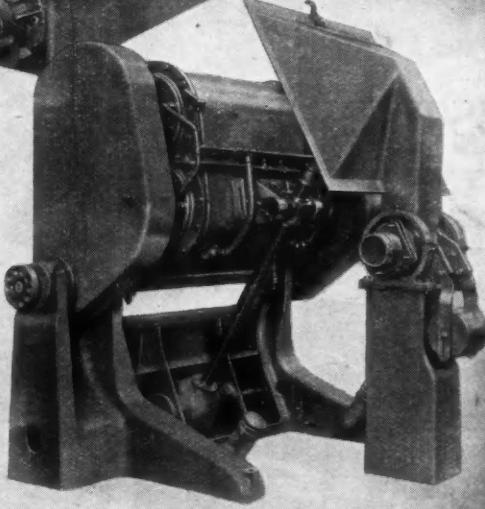
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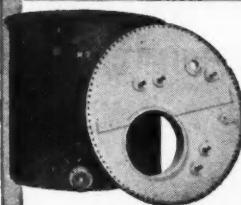
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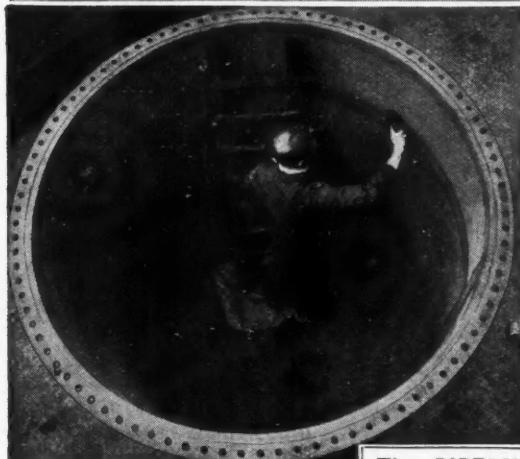
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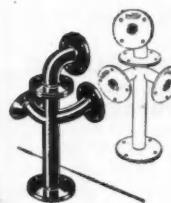
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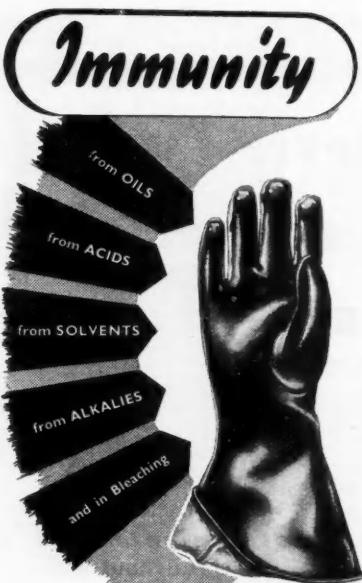
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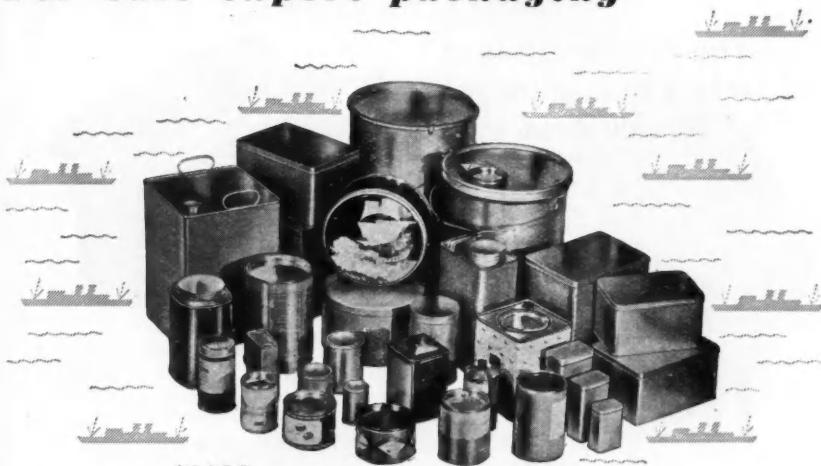
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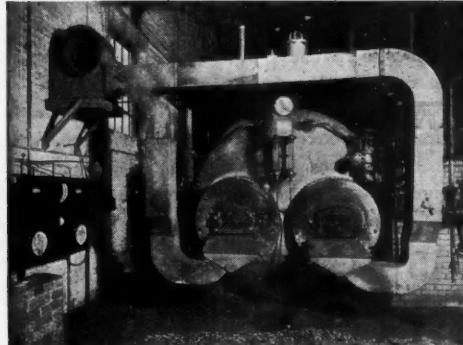
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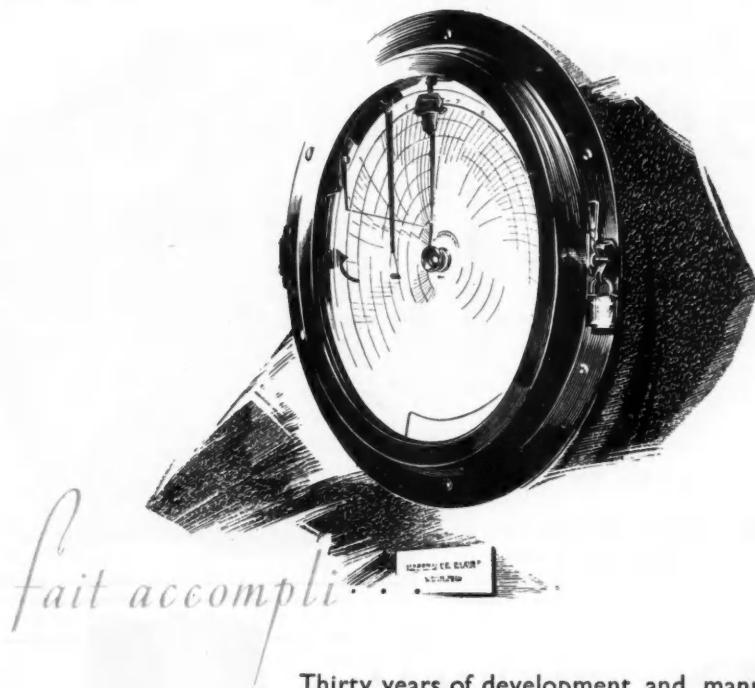
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Volume LXIII

2 September 1950

Number 1625

Man's Use of Energy

SIR HAROLD HARTLEY, in his presidential address to the British Association, entitled "Man's Use of Energy", reviewed man's use of and demands for energy throughout the ages, which he pointed out, had helped so much to shape the course of history. With the many new uses of energy, which were being found every day, and the growing population, the world's demands were rising constantly. The question he had to deal with was, how could those demands be met?

Sir John Russell's problem last year of the world's demand for food was simple compared with his (Sir Harold Hartley's). There was, however, a limit to the capacity of the human stomach, but none to a man's appetite for energy.

In endeavouring to find ways of meeting the world's present and future energy demands one came up against the necessity of estimating how long the world's resources can, in fact, satisfy these growing requirements. Sir Harold opined that the world's reserves of coal were ample for centuries to come. Also, the position of oil at least gave no cause for immediate alarm. Reserves of oil and natural gas were smaller, he said, and harder to define, but fresh fields were being found and there was no need to

fear a shortage for several decades.

Before that shortage eventuates, Sir Harold reminded his audience with assurance, synthetic oil from coal and the huge reserves of oil in shale will provide substitutes. He, however, uttered the timely reminder that the world's energy problems of the future are not limited to heat and power alone, and that reserves of fertilisers for the growth of food, and of metals for the machine age in which we live, are of equal moment.

The position of fertilisers, as seen by Sir Harold Hartley, is also a satisfactory one. Fortunately for agriculture, he gave the assurance, the deposits of potash and phosphates will meet the world's needs for centuries, and nitrogen we can fix from the air. The reserves of phosphates and potash, however, are most unequally divided, marking the dependence of one country on another.

A much more difficult problem might be presented to the world by the reserves of metals. There would be no lack of iron, aluminium or magnesium, although with lower grades of ore the cost might rise. Estimated reserves of copper, lead, zinc and tin were adequate only for some decades, and if all the world used them at the same rate as the U.S.A. there might be

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shortages within ten years. Geologists were not optimistic of finding large new ore fields, and so would be faced with an iron/light alloy metal economy, reserving certain non-ferrous metals for the uses for which they were essential. Here again, pointed out Sir Harold Hartley, the accidental distribution of ore deposits revealed in an acute form the inter-dependance of countries.

Prominent among the problems the world was facing to-day were the claims of the less developed countries. Their needs were transport, fertilisers, irrigation, heat and power—transport to diversify their social and economic pattern, fertilisers to sustain and increase fertility, irrigation to bring the water on which all life depended, and heat and power to develop their indigenous resources.

All that meant fresh demands, mused Sir Harold. The nineteenth century was wasteful of its easily won materials, but now, thanks to the continuous improvements in technique, the world's demands for heat and power were being met largely by greater efficiency. Taking a look into the future, Sir Harold wondered what new means of tapping Nature's stores of energy were likely to emerge and bring it where it was needed.

The unequal distribution of energy sources would, he suggested, make its transport of increasing importance in the future, and here the possibility of transmitting electric power over long distances by high-voltage direct current had passed the experimental stage and was waiting for development. Sir Harold referred to the tides in favoured spots as being obvious sources of energy, and he said it was tantalising to think of the immense amount of energy reaching the earth by solar radiation and the small use we made of it.

Referring to nuclear energy, Sir Harold said its story showed what could be done if science were used lavishly with all the resources of the modern world to penetrate Nature's secrets. Then came the task of using Nature's great storehouse for the good of man. The by-products and radiations of the nuclear plants were so dangerous to life that their operation was only made possible by automatic controls.

Man's hope for the future, as suggested by Sir Harold Hartley, lies in his new understanding of Nature's processes, in his more efficient use of her resources and in the growing recognition of the dependence of one nation on another. And who can disagree with Sir Harold?

Notes and Comments

The British Association

POPULAR interest in science today makes it strange to recall the early struggles of the British Association for the Advancement of Science when it was ridiculed even by *The Times* and Dickens poked fun at it in his "Mudfog Papers," which claimed to be accounts of the meetings of the "Mudfog Association for the Advancement of Everything." Today the "British Ass" is held in universal esteem and its wide appeal is reflected not only in the Press but also in the fact that the B.B.C. is devoting four programmes to this year's 112th meeting in Birmingham. Long experience has shown that local interest is a great asset and Birmingham with its combination of academic knowledge and technical experience has contributed much to science. The chemist, indeed, may consider the location well chosen, for it was in this city in 1746 that the partnership of Mr. Samuel Garbett and Dr. John Roebuck resulted in the production of sulphuric acid by the lead chamber process, the beginnings of chemical manufacture in the modern sense of the term. It is strange that among its wide and diverse activities the British Association has no section devoted to metallurgy, particularly this year, when its host is a city distinguished for its achievements in this branch of science.

Success through Science

THAT the achievement of success in a country's industrial activities is dependent upon their being firmly founded on a scientific basis was the opinion expressed by Dr. A. Parker, director of fuel research to the DSIR, during his lecture on "Man's Use of Solar Energy," at the Midland Institute, Birmingham, last week. This was one of a series of lectures arranged to precede the annual meetings of the British Association. Dr. Parker reminded his audience that the earth had received, and was still receiving,

an enormous amount of energy from the sun. The coal equivalent of all the energy resources being harnessed and used by man to meet his needs was about 3200 million tons a year, or an average of about 1.5 tons per person; in the U.S.A. it was more than eight tons per person, and in Great Britain about four tons. In the past, fuels had been relatively cheap and had, in consequence, not been used efficiently, but great advances had been made in the last 50 years in the science and technology of power production and utilisation and further rapid advances would certainly be made in the future. Britain was the first to realise the value of fuel and power and to exploit her coal resources in the development of industry. Other countries with good coal reserves followed, and the U.S.A. also began to exploit her petroleum resources. In consequence, industrial competition had become acute, and national ability, skill and hard work had had to play an increasingly important part in achieving success. "With our native talent," said Dr. Parker, "we can achieve success provided that our activities are based on a foundation of scientific and technical knowledge and research, and that we avoid all unnecessary waste, whether of manpower or material."

Chemistry in Agriculture

IN the survey of British agriculture, published last Monday as a supplement to the *Financial Times*, in an article entitled "The Chemist's Rôle," by Mr. R. W. Haddon, managing editor of *Farmer and Stock-Breeder*, the chemist is given a deservedly liberal measure of praise for his contributions to the solving of post-war farming problems. The author draws attention to the tremendous amount of detailed work, in many cases going back for years, that has culminated in, say, the application of a new principle, or product on a practical scale, the

work which goes on at the universities, in Government laboratories and, possibly most important of all, in the research sections of the big industrial firms concerned. He reviews the strides which chemists have made in recent years in the discovery of effective insecticides, fungicides and weed killers, but he says nothing of the problems which remain to be solved in connection with protecting the life and health of farm workers to whose lot it falls to employ some of these chemical preparations (*THE CHEMICAL AGE*, 63, 184). The chemist has done, and is still doing, his job—and doing it very well—but the farmer must back him up. It is all very well to adopt the attitude that the chemist, having discovered these chemicals which are toxic to farm pests and noxious weeds, will assuredly be clever enough to improve upon them and make them sufficiently toxic for their original purpose yet non-toxic—or considerably less toxic—to man. This is not so easy as may be supposed by those uninitiated in chemical matters, and the attitude is one which seeks to ease the conscience of the farmer by relieving him of the necessity for properly instructing his workers in the safe use of toxic chemicals, and a strict oversight in the matter of the wearing of suitably protective clothing.

Technical Skill

THE publication of a report by the Parliamentary and Scientific Committee on "Technical Education and Manpower" indicates that some concern is felt over the matter of training skilled craftsmen to meet Britain's increasing industrial need. The report suggests several methods by which the present unfavourable position could be improved, not the least of them being the necessity for industrial firms to do their share. It is urged that the development of part-time day release from industry should be immediately and more widely supported, that more industrial firms should give training in the "skills" of the various trades and crafts and that permission to qualified men to act as part-time day teachers in technical colleges should be more

freely granted. Economically, and in the quality of trained technicians, Britain has not yet recovered from the effects of the last war. From this admittedly sombre viewpoint alone there is a vital urgency for more and better skilled craftsmen. The proposal that industry should do more to train skilled technicians will probably meet with a mixed reception. A fair criticism would appear to be that, while the necessary buildings and equipment are but slowly forthcoming, any action taken by industry must necessarily be hindered and limited to a rate at which the essential buildings are completed. Another contention is that, while there is a relatively small technical element in the secondary education of the young people who will enter industrial employment, there is the unsatisfactory possibility that industry, if it undertakes the task of training skilled craftsmen, will, in fact, have to work with needlessly "raw" material. Both these arguments are reasonably valid and are to some extent allowed for in the recommendations of the report. The lead must come from the top, however, and it is where the report urges changes and improvements that can be effected by the Ministry of Education that it does its best service. Only when sufficient opportunity exists for industry to play its part in the technical education of to-morrow's craftsmen will there be a strong case to be made out against the employers. In the meantime, there is no need for complacency. There is much that industry can do, and if the suggestions contained in the report are acted upon then improvement will come.

New Gas Research Laboratories

The importance of research to the development of the gas industry will be emphasised today (Saturday, September 2) when the central and research laboratories of the West Midlands Gas Board will be opened at Nechells, Birmingham, by Sir Harold Hartley, president of the British Association for the Advancement of Science. Planned in 1938, but delayed by the war, the new building forms an extension to existing laboratories.

CHEMICAL IMPORTS RISE

Engineering Items More

JULY imports of chemicals, drugs, dyes and colours were again marked by substantial increases in most items. The total value for the month was £2,958,829, which was only slightly higher than the figure for June, but was over £1 million more than the same period of 1949.

Gas and chemical machinery, which had shown a decline in June, was one of the largest rises with a value of £51,558 compared with £8,454 in 1949. Despite decreases in potassium sulphate and sodium nitrate, total imports of the potassium and sodium compounds were again higher.

Other notable increases were: carbon blacks £376,150 (£72,279); paints and extenders £546,037 (£159,943); and essential oils £387,807 (£185,465).

	July, 1950	July, 1949
	Cwt.	Cwt.
Acetic anhydride	7,348	3,899
Acetic acid	—	4,536
Boric acid	7,200	6,180
Carbolic acid	4,921	—
Value of all other sorts of acid	£34,055	£89,558
Borax	25,344	19,000
Calcium carbide	—	1
Cobalt oxide	804	849
Fertilisers	—	200
Glycol ethers and glycol ether-esters	397,721	420,726
Iodine	—	132,100
Potassium chloride	836,514	700,963
Potassium sulphate	19,800	33,000
All other potassium compounds	10,117	1,525
Value of all potassium compounds	£666,130	£587,523
Sodium nitrate	23,622	35,896
All other sodium compounds	14,405	7,760
Value of all sodium compounds	£117,112	£53,821
Spirits—Chemical manufactures, etc.	—	—
Value	£942,637	£452,983
Dyes and Dyestuffs	Cwt.	Cwt.
Synthetic organic dyestuffs	1,012	783
Extracts for dyeing	2,361	595
Extracts for tanning (solid or liquid)	70,007	72,423
All other dyes and dyestuffs	108	505
Paints and extenders	Cwt.	Cwt.
Earth colours (except black)	48,306	45,277
Carbon blacks from natural gas	88,922	22,179
Value of carbon blacks	£376,150	£72,279
Other, including vegetable, lamp, acetylene and bone.	17,442	1,557
Value of paints and extenders	£546,037	£159,943
Value of chemicals, drugs, dyes and colours	£2,958,829	£1,943,137
Essential oils (other than turpentine)	434,355	249,240
Value of essential oils	£387,807	£155,465
Synthetic oils	4,996	3,197

(continued at foot of next column)

U.K. MISSION TO PAKISTAN

Report on Chemical Industry

PROSPECTS of developing the chemical industry in Pakistan are reviewed in the third part of the report of the United Kingdom Industrial Mission which went to Pakistan in February, now published (HMSO, 7s.).

The mission, which was the result of an invitation by the Government of Pakistan, was led by Lord Burghley and included among its members men with expert knowledge of the chemical, electrical, and textile industries.

In general, the report states, the heavy chemical industry, either in West or East Pakistan hardly seems to offer a fruitful or profitable field for expansion in the near future; heavy chemicals not made already could continue to be imported and the market expanded where desirable by a vigorous selling policy. As and when chemical plants are required in Pakistan there will be no lack of suppliers in the United Kingdom.

There should be ample scope for the erection in Pakistan of small plants in the field of industries allied to the chemical industry, with the intention of importing in bulk and carrying out relatively simple processes, in some cases completely replacing imports, or producing finished products for export where raw materials are at present exported.

When a factory is being set up it is recommended that in many cases the establishment and organisation are better handled by the suppliers of the plant in the early stages and from the outset.

Finally, the mission suggests that a thorough "all-round" training for chemists, rather than a highly specialised and necessarily narrower course, would be to the real benefit both of the individuals concerned and of the chemical industry.

The most serious problem is the present shortage of experienced executives and skilled technicians in Pakistan. The engagement of British technicians on short-term contracts is suggested until a long-term training policy can begin to take effect.

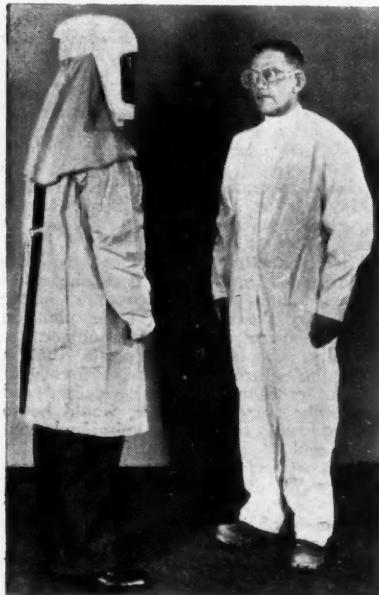
	Cwt.	Cwt.
	Tons	Tons
Wax, petroleum: paraffin wax	79,129	21,277
Value of oils, fats and resins	£10,928,889	£8,548,411
Sulphur	29,050	28,865
Value	£293,534	£237,876
Gas and chemical machinery	7,475	508
Value	£51,558	£8,454
Plastic materials	27,950	18,159
Value	£545,098	£300,904

CHEMICAL-PROOF CLOTHING

Lightness and Durability

COMFORT and durability are the main problems continually confronting the manufacturers of chemical-proof clothing. Production of a lightweight material which is flexible, resistant to abrasion and tearing, and impervious to industrial chemicals is the ideal to be aimed at.

Such a material is claimed by the protective industrial clothing division of the R.F.D. Company. Made of high-grade cotton proofed on both sides with PVC, the product weighs only 8½ ozs. to the square yard. It is simple to clean, and is claimed to be resistant to acids, alkalis, oils and greases, and various miscellaneous chemicals such as aluminium chloride and hydrogen peroxide.



New styles in R.F.D. protective clothing. Generously cut to allow freedom of movement without loss of protection, special attention has been paid to ventilation. Range of garments includes bib and brace overalls, bib type aprons, jumpers, hoods, surgeon's type coats, trousers, wader type trousers, combination suits and laboratory coats and other garments

EXPORT LICENSING Some Chemical Changes

A NUMBER of changes in export licensing control are made in a Board of Trade Order (Export of Goods (control) (Amendment No. 3) Order 1950) which came into operation yesterday, September 1.

Among the goods which will not require export licences are specified starches, certain essential oils, other oils and fats, putty and aqueous emulsions of bitumen.

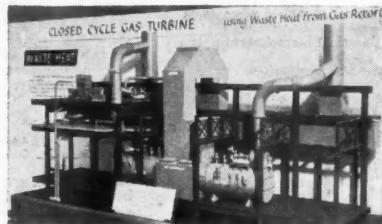
Controls are being tightened over a range of goods formerly freely exported to many European countries. These goods specified in the Third Schedule of the Control of Goods Consolidation Order 1949 (as amended) are mostly chemicals, metals and machinery, and can now only be exported under licence. Styrene and dichlorostyrene have been added to this schedule.

A few drugs have been added to the list of goods which require licences for export to any country.

Birmingham Industrial Museum

APPLICATIONS of science to industrial processes will form a section of the new industrial museum which is to be opened at premises in Newhall Street, Birmingham.

Continuous evolution of methods and machines will be exhibited, with emphasis on progress since the beginning of the Industrial Revolution. A search is being made in the West Midlands for 18th century machines to form part of the collection.



Model of a new gas turbine, using waste heat on a closed cycle principle, specially made for installation in a gas works. This formed part of the Gas Council's display at the exhibition held in conjunction with the British Association's meetings at Birmingham. A turbine of this type will shortly be installed in a West Midlands gas works

SCIENCE AND THE GOVERNMENT

Work of the Advisory Council

THE work of the Advisory Council on Scientific Policy was outlined by its chairman, Sir Henry Tizard, in an address to a meeting of the Parliamentary and Scientific Committee held on July 25. The terms of reference were quite simple, namely: To advise the Lord President of the Council in the exercise of his responsibility for the formulation and execution of Government scientific policy. It did not detract in any way from existing research organisations but enabled their collective experience to be used on problems which concerned all, but were not specifically the province of any single one.

Examples of problems put before the council were referred to by Sir Henry. One was the introduction of a seaweed indigenous to this country. It was decided the probable danger more than outweighed any industrial advantage. Another important matter still under consideration was that of toxic substances in consumer goods.

The importance of increasing productivity during the next two or three years had resulted in the setting up of the Committee on Industrial Productivity. The problem was now engaging a number of other bodies and the committee did not now feel there was much point in its existence.

Referring to the report of the council on technical education, Sir Henry admitted that although fundamental research was in good hands, there was still cause for some concern when it came to the application of science.

Equipment Value

Availability of capital expenditure was also an important point. Our manufacturing industry was capitalised at a much lower scale than in the U.S.A. At present costs, the capital value of the equipment in manufacturing industries was about £1000 per man employed. In a recent American survey of one hundred of the chief manufacturing firms the capital value of equipment was \$12,000 per man employed, i.e., over £4000.

This was one of the chief difficulties which must be borne in mind when comparing industrial productivity in this country with others. It would be a long time before it would be possible to bring up the capital equipment of manufacturing industries to the point it should be, if we were going to keep our position in the world.

The importance of promoting all branches of technical education could not be over-emphasised. The Advisory Council had mainly considered higher technological education. Sir Henry took the view that there should be more institutions of the highest class devoted to research and education in technology. He himself felt it was not at all necessary to have them part of a university: others felt that the universities could cope with the whole problem.

Technical Colleges

In the recent science debate in the House of Commons reference had been made to the Imperial College. There was a difference between that college and the applied science departments of a good many universities, because the Imperial College had a governing body of its own, appointed its own teachers, except professors who were appointed by the University of London, and set its own examinations.

We must aim at a policy of getting colleges similar to the Imperial College set up, but in other parts of the country and in Scotland. If they were to be linked to universities they should, in his view, be modelled on the Imperial College.

With regard to the question of scientific manpower, the Ministry of Labour had made a very careful inquiry into the probable supply of and demand for scientists in various fields in the next three or four years. Figures of supply had been obtained from the universities and care taken to get good estimates of demand, with assistance from expert committees on which prominent scientific men had served.

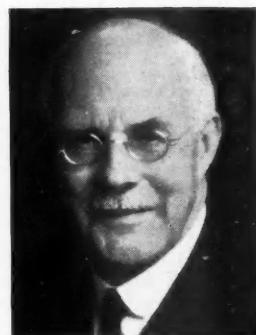
The conclusion he did not like was that, in general, university departments had expanded sufficiently to satisfy the demand, except in the fields of chemistry and chemical engineering, and in particular that the present rate of output of graduates with biological qualifications may result in a surplus within the next five years.

Sir Henry felt that this might discourage young men who wished to have a biological education from following their inclinations, which was a serious thing to do. We were confused in two ways: inquiries only resulted in finding out the "wants" of people, they did not discover "What does the nation need?"

Chemistry and the British Association A Well Selected Programme



The Duke of Edinburgh (left), who will be president of the British Association next year on the occasion of the Festival of Britain when the meeting will be held in Edinburgh. Right: Sir Harold Hartley, this year's president



Nearly 2000 scientists assembled in Birmingham this week for the 112th annual meeting of the British Association for the Advancement of Science which continues until next Wednesday.

"Energy in the Service of Man" is the general theme of the 270 papers being delivered at this year's conference, at which chemistry is again well-represented by a programme covering four main topics: carbohydrates; natural synthetic polymers; chromatography; and differing aspects of chemical energy.

The Chemistry Section

Section "B" was opened on Thursday, August 31, by Professor E. L. Hirst, with his presidential address on "Modern Developments in Carbohydrate Chemistry" (see page 321).

Seaweed polysaccharides formed the subject of the first paper by Dr. E. G. V. Percival, who followed the president. Cellulose, he said, was the only polysaccharide of land plants definitely known to be present. Other "normal" seaweed polysaccharides were laminarin and Floridean starch, both polyglucosans, and a xylan. The polymannuronic acid, alginic acid, was the principle structural component of the brown seaweeds and ethereal sulphates such as carragheenin, containing both *d*- and *l*-galactose, and fucoidin (containing *l*-fucose) were characteristic and unique members of this group of substances.

Professor S. Peat followed with a talk on the enzymes associated with starch metabolism. Most starches consisted of two components, amylose and amylopectin.

Both were polyglucoses of the same basic pattern but amylose consisted of unbranched chains of glucose units whereas amylopectin had a branched structure. R-enzyme, a newly-isolated enzyme, alone appeared to be capable of hydrolysing the branch links. The starch-synthesising enzymes were *phosphorylase* and *Q-enzyme*, which acting together were responsible for the conversion of glucose-1-phosphate into amylopectin.

The degradation of high polymers and the importance of this subject in rubber chemistry and in synthetic fibre chemistry in regard to the thermal and photochemical stability of such materials, were emphasised by Professor H. W. Melville at the opening session yesterday (September 1).

Polymer Fibres

The three main methods of regeneration—the dry, the wet, and the melt spinning techniques—developed in the formation of fibres from polymer molecules were described by Dr. F. H. Happey in the paper which followed. Physical methods used in the study of these fibres were discussed and some demonstrated in a comparison of the fibre-forming properties of polythene, the nylons, terylene, and the synthetic polyesters and polypeptides.

Papers next week, will deal on Monday with chromatography, the authors being Dr. T. I. Williams, Dr. C. E. Dent and Dr. F. H. Pollard, while on Tuesday chemical energy will be the subject of addresses by Professor F. H. Garner, Dr. James Taylor, Dr. H. J. T. Ellingham and Professor F. G. Gregory.

CARBOHYDRATE CHEMISTRY

Some Modern Developments

Abstract of an address given to section 'B' by Professor E. L. Hirst, Forbes Professor of Chemistry, University of Edinburgh, as president of the chemistry section, at the 112th annual meeting of the British Association now being held in Birmingham



Professor E. L. Hirst

ONE of the main reasons for the comparatively slow progress in sugar chemistry in the early years was the lack of an accurate knowledge of ring structure. It had been assumed, largely by analogy with the stable γ -lactones of hydroxy acids, that a similar five-membered ring occurred in the normal sugars, but as knowledge of the properties of sugar derivatives increased many anomalies appeared and there followed a period of confusion and uncertainty.

The work of Purdie and Irvine, of the University of St. Andrews, however, led the way in the development of carbohydrate chemistry with the observation that by the action of silver oxide and methyl iodide on lactic acid both the carboxyl and the hydroxyl groups underwent methylation. The reaction with alcoholic groups was found to be general and it became possible for the first time to label with easily recognisable groups the free hydroxyl groupings present in carbohydrates. Since these methyl ethers resisted chemical action during subsequent operations, method was provided whereby the points of junction of the substituents in a sugar molecule could be detected. To use this procedure it was necessary to have ready as standard reference substances a series of partially methylated derivatives, for example, 2:3:6-trimethyl glucose, in which the position of the methyl groups was known with certainty.

Methylation Method

A further stage in the structural investigations was the application of the methylation method to the determination of the nature of the rings present in the

sugar molecules. It was used to ascertain the ring structure of the stable α - and β -forms of methylxyloside, obtained from xylose by the action of methyl alcohol in the presence of hydrogen chloride. On methylation or by using dimethyl sulphate and sodium hydroxide, the fully substituted methylxylosides could be prepared without risk of any change in the nature of the ring system and trimethyl xylose was readily obtainable from these by acid hydrolysis.

Pyranose

Trimethyl xylose on oxidation with nitric acid gave the internally compensated optically inactive trimethoxy glutaric acid, and it followed that the ring system present in normal methylxyloside must be a six-membered one containing an oxygen bridge between the first and the fifth carbon atoms. For this type of ring, the designation pyranose was subsequently proposed.

An elaboration of the method fixed the ring structure in α -methylglucoside, since on methylation this gave rise to a tetramethyl glucose, which an oxidation with nitric acid yielded the same inactive trimethoxyglutaric acid. It therefore became evident that the normal derivatives of glucose contain a six-membered pyranose ring instead of the five-membered ring which had previously been assumed. The way was then clear for a general attack on the problem of ring structures in simple and compound sugars.

The ordinary stable varieties of the sugars and their methylglycosides were found to possess the pyranose structure while the unstable, readily hydrolysable methylglycosides, of which Fischer's " γ "-methylglucoside is a typical example,

possessed the five-membered furanose ring.

Efforts were made to determine the ring structures present in the disaccharides, but the problems here are more complicated since it is necessary to determine (a) the nature of the ring present in each of the two residues; (b) the point of junction between the residues; (c) the nature of the glycosidic group involved.

The disaccharides methylation followed by hydrolysis frequently gives only a partial answer to the problem of structure. For instance, the fully methylated derivative of maltose yields on hydrolysis an equimolecular mixture of 2:3:4:6-tetramethyl glucopyranose and 2:3:6-trimethyl glucose. Inspection of the formulae of the latter substance shows that free hydroxyls on both C₄ and C₆ are available for the engagement of the ring, and it follows that the isolation of this particular trimethyl sugar leaves open two possibilities for the ring form of the corresponding glucose residue as it occurs in the disaccharide.

Maltobionic Acid

Further evidence is required before a choice can be made between the two alternative structures for the disaccharide which might be either 5-glucopyranosido-glucofuranose or 4-pyranosido-glucopyranose. If instead of the free sugar the open chain derivative maltobionic acid is subjected to methylation, every position in the residue which originally carried the reducing group is now available for substitution, except that carbon atom which is involved in the junction of the two glucose residues. Hydrolysis of the fully methylated maltobionic acid will therefore yield, in addition to tetramethylglucopyranose, a tetramethyl gluconic acid which possesses one free hydroxyl group.

The position of this hydroxyl group fixes the point of junction of the two residues and hence, by taking into account also the isolation of 2:3:6-trimethyl glucose in the direct methylation experiments, the nature of the ring is fixed also. In this way maltose was proved to contain two pyranose residues linked through positions 1 and 4, and other evidence indicated that an α -glucosidic link was involved.

New Structures

By suitable variations of the procedure the structure of lactose (4β -galactopyranosido-glucopyranose), cellobiose (4β -glucopyranosido-glucopyranose), gentiobiose (6β -glucopyranosido-glucopyranose), and of other disaccharides and trisaccharides were established. Sucrose (α -glucopyranosido- β -fructofuranoside), one of the most important of the disaccharides,

presented special difficulties and some time elapsed before the structure of the fructose portion was established.

The clearest proof that the ring structure is of the furanose type was provided by a study of the action of permanganic acid on the substance obtained by the mild oxidation of tetramethyl fructose. Elimination of carbon dioxide took place and 2:8:5-trimethyl-D-arabonolactone was formed. Rotational evidence obtained during hydrolysis experiments gave strong indications that the molecule contains an α -glucosidic and a β -fructosidic group.

It is curious that sucrose has resisted all attempts to synthesise it by purely chemical methods. Despite the most intensive work no trace has yet been found of natural sucrose when the combination of glucose and fructose possessing the correct ring structures has been effected, although an iso-sucrose, differing from the natural product only in the nature of the glycosidic links, can be obtained in this way.

Recently it has been found that α -D-glucose 1-phosphate and D-fructose give natural sucrose in good yield under the influence of an enzyme present in the bacterium *Pseudomonas saccharophila*, an enzymatic synthesis of cane sugar being thus achieved.

Nucleic Acids

In addition to O-glycosides, nitrogen analogues exist also, formed by the union of a sugar with an appropriate amine. Methods have been elaborated whereby N-glycosides containing the highly reactive D-ribofuranose residue can be formed and in this way syntheses of nucleosides and nucleotides have been achieved, including, for instance, adenosine triphosphate. These are of particular importance in connection with the chemistry of the biologically significant nucleic acids and co-enzymes.

The methylation method still remains one of the most valuable of all those available to the sugar chemist, but the carbohydrate molecule is so labile and so versatile in its behaviour and the problems it poses are so complex that the widest possible variety of physical and chemical methods are now required for the determination of structure.

The evidence for the relative dispositions of the α - and β -groups in glucose has been sought by methods so widely divergent as conductivity measurements in borax solution and X-ray crystallographic analysis. The comparative rapidity with which the chemistry of ascorbic acid and its derivatives was worked out depended upon X-ray and ordinary crystallographic measure-

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ments and on the study of optical rotatory dispersion in the ultra-violet region, in addition to the classical methods of organic chemistry and novel applications of the methylation process.

- (i) $\text{R}.\text{CHOH}.\text{CHOH}.\text{R} \xrightarrow{\text{HIO}_4} \text{R}.\text{CHO} + \text{OHC}.\text{R}$
- (ii) $\text{R}.\text{CHOH}.\text{CHOH}.\text{CHOH}.\text{R} \xrightarrow{\text{HIO}_4} \text{R}.\text{CHO} + \text{OHC}.\text{R} + \text{HCOOH}$
- (iii) $\text{CH}_2\text{OH}.\text{CHOH}.\text{R} \xrightarrow{\text{HIO}_4} \text{H}.\text{CHO} + \text{OHC}.\text{R}$
- (iv) $\text{CH}_2.\text{CHOH}.\text{R} \xrightarrow{\text{HIO}_4} \text{CH}_2.\text{CHO} + \text{OHC}.\text{R}$

Of other reagents which have found important uses in carbohydrate chemistry, periodic acid is of special significance and the limits of its usefulness have by no means been reached. Like lead tetracetate, this substance has the property of attacking glycols which contain hydroxyl groups on contiguous carbon atoms, the carbon-carbon bond being broken with the formation of two aldehyde groups. One or two examples chosen from widely differing problems may be given to illustrate the versatility of the reagent.

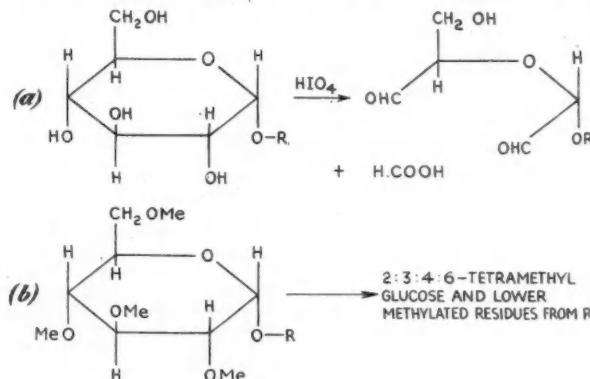
(a) Sodium periodate attacks the free sugars, in many instances quantitatively, liberating formic acid, and so providing a convenient and accurate method for the micro-analytical determination of the sugars. Under appropriate conditions

work on alginic acid, reacted with periodic acid yielding a methylated aldehyde, and the latter on further oxidation gave *i*-dimethoxy succinic acid. The original substance was, therefore, the 2:3 dimethyl derivative of mannuronic acid.

(c) The problem of the disposition of the methoxyl groups round the first carbon atom of the α - and β -forms of the methylglycosides has been studied by the use of periodic acid. In the case of α -methyl-*D*-glucoside many independent lines of evidence point to the arrangement depicted below in which the $-\text{OMe}$ group is situated beneath the plane of the ring.

By means of an ingenious application of the use of periodic acid it has been confirmed that this spatial arrangement holds generally for all α -methyl-*D*-hexopyranosides and hence also for the α -forms of the sugars. During the oxidation of the methylglycosides a dialdehyde is formed and on further oxidation with bromine water this readily gives the corresponding acid which can be isolated as its strontium salt. In this the original oxygen bridge is still intact, but the optically active centres at C_2 , C_3 and C_4 have disappeared. All α -methyl-*D*-hexopyranosides should, therefore, give the same product and this is found to be the case.

In a similar way β -methylglycopyranosides of the *D*-series, for which the arrangement of the groups round C_1 is enantio-



terminal $-\text{CH}_2\text{OH}$ groups yield formaldehyde and $\text{CH}_2.\text{CHOH}-$ groups acetaldehyde, both reactions finding important analytical uses.

(b) It may often be employed to establish the position of the methyl groups in partially methylated sugars. For instance, an unknown dimethyl mannuronic acid, which was encountered in the course of

morphic to that present in the α -derivatives, give rise to a product which differs from the strontium salt just mentioned only in respect of the spatial arrangement at C_1 .

(d) One of the most valuable applications of periodic acid is for the detection and estimation of terminal sugar residues which are present in complex carbohydrates. A

polysaccharide of the structure shown in (A) may be considered, in which there is a terminal glucose residue, attached to the remainder of the molecular structure R, which contains no other terminal groups, reducing or non-reducing, and no residues linked exclusively through their C₁ and C₆ positions.

When such a molecule is oxidised by periodate it is clear that the terminal residue will give rise to formic acid, the amount of which enables a direct calculation to be made of the proportion of the end group in the molecule. Wherever conditions are suitable, this method is particularly convenient since it can be carried out on the micro-scale, permitting end-group determinations to be made in a day or two with only milligrams of material. It has been used extensively to supplement the methylation method for the assay of end groups in amylopectins and glycogens, and other polysaccharides.

Complications arise when the molecule contains free reducing groups or chains of hexose residues linked solely in the C₁-C₆ positions and in such cases there is at present no alternative to the more general, but lengthier, methylation method (B) for the determination of end groups, which was first used in the course of work on cellulose.

(e) Another promising development of the periodate method is its use in the study of complex polysaccharides which contain many branched chains, such as are found in amylopectin, glycogen and in plant gums and mucilages. A terminal hexopyranose residue is attacked with liberation of formic acid. On the other hand a hexopyranose residue which is linked to others solely through its C₁ and C₆ positions will be oxidised to a dialdehyde by periodate, whereas if the links are through C₁ and C₃, the residue will remain unattacked.

Unattacked Sugar Residues

Again, if a branch chain is attached at either of the positions C₂ or C₃ in one of the residues of a long chain of C₁-C₆ linked residues, treatment of the substance with periodate will result in the oxidation of all the sugar residues except that one in which the point of branching occurs. If the oxidised polysaccharide is then hydrolysed, the nature and the amount of the unattacked sugar residues may be determined. These methods have already proved their utility in structural work on the starches and gums.

The application of chromatography to carbohydrate chemistry is of outstanding importance. One of the major difficulties of sugar chemistry has always been that

of the qualitative and quantitative separation of mixtures of sugars. These substances resemble one another so closely in physical and chemical properties that separation is always difficult and frequently has to depend on some specific reaction which is, unfortunately, rarely quantitative. Nevertheless, a great deal has been accomplished on these lines, and if sufficient material is available it is usually possible to identify the components of a mixture.

These methods however, demand large quantities and progress in important investigations has been retarded by the difficulty of securing materials on an adequate scale. Similar problems are encountered in the study of polysaccharides by the methylation method when the hydrolysis of the fully methylated derivative may give rise to a complex mixture of monosaccharides of different kinds and of various degrees of methylation.

A New Approach

Much can be done by preferential extraction from solution by immiscible solvents and by fractional distillation under diminished pressure, but it became clear some years ago that the limits of usefulness of these methods were being reached and there was urgent need for a new approach.

This has been provided by partition chromatography which has developed with amazing rapidity in the sugar field since Partridge first applied the filter-paper-strip technique to the separation of simple sugars, using solvents such as butanol-water mixtures for the development of the chromatograms.

Complex mixtures of sugars, including their methylated derivatives, can be separated and determined quantitatively on a scale of milligrams or, in favourable cases, of micrograms. Furthermore, by the use of columns of powdered cellulose and an automatic device for collecting fractions of the eluate, these workers have succeeded in carrying out quantitatively the separation of mixtures on a larger scale, obtaining a sharpness of separation which had hitherto been quite impossible to achieve.

Both in sensitivity and in range the chromatographic methods far exceed the earlier procedures and for the time being the limiting factor in the structural study of the complex carbohydrates resides not so much in the separation and identification of the various sugar residues as in the difficulty encountered in hydrolysing the polysaccharides without damage to the component sugars.

PRIMARY AUTOXIDATION IN OIL DRYING

Chemical Aspects and Mechanism

RECENT research in the field of primary autoxidations in unsaturated fatty acids has been mainly on simple esters or, more rarely, on free fatty acids. Polymerisations are only involved in so far as they are closely connected with this primary autoxidation. That these unsaturated acids are mostly used in the form of triglycerides is relatively unimportant. The fatty acids concerned are those of the linoleic and linolenic type.

A comprehensive review of recent work in that important field was given recently by Professor Wilhelm Franke of Cologne University, at a meeting of the paints, etc., group of the German Chemical Society, in Hamburg. It has now been published in full, with nine curves and 75 references.¹

The bridge or ethylene peroxide theory of Fahrion and others obtained considerable support in the earlier literature; but in 1936 Rieche opposed this with his hydroperoxide theory. It is here discussed at some length in respect to basic considerations, experimental, and side and supplementary reactions. Oxygen is assumed to enter the CH_2 groups where activated by proximity to double bonds, forming fatty acid hydro-peroxides. Ten years earlier Scheiber had already postulated formation of similarly constituted ketones through autoxidation. Rieche had, in fact, merely transferred to fatty acids the analogous results obtained with cyclic hydrocarbons such as tetralin and cyclohexene; and his theory was subject to the serious objection implied in the drop in iodine number of autoxidised unsaturated fatty acids.

Spectrographic Study

On the experimental side, the important work of Farmer and co-workers to some extent restored the Rieche hypothesis, but on other grounds, based on spectrographic observations by Bolland and colleagues^{2,3} working first with a high fatty acid (C_{22}) from fish liver oil, and then with linolenic ethyl ester. Curves show changes in the absorption spectrum and oxygen absorption for linolenic ethyl ester and reference is made to earlier experiments of van der Hulst and to the later research of Kaufmann and Keller who noted the formation of conjugated unsaturated diene and triene fatty acids in vegetable oil stored with air admission. Farmer and co-workers had, however, supposed that the peroxide

group as such did not contribute to absorption in the spectrum region of 2300 Å, and this was later confirmed by Bergström.

According to the Farmer theory the first phase of autoxidation of the "methylene-interrupted" double bond system consisted in the freeing of a hydrogen atom from an activated CH_2 group, thus leaving an olefinic radicle stabilised by resonance with two conjugated unsaturated structures, or, as Sidgwick called them, resonance hybrids. These and kindred matters are discussed in relation to the literature, such as the work of Bolland and co-workers Bergström and others, including effect of hydrogenation and the significance of the extinction coefficient (ϵ).

Enzymatic Autoxidation

By way of supplement to the chemical aspects, enzymatic catalysed autoxidation may be briefly noted. In soya beans and other legumes there was evidently an enzyme that could catalyse peroxidation of non-conjugated unsaturated fatty acids, whether in the form of soap solution or ester emulsion. Some recent references (1948-50) are given — Bergström, Holman and others, on isolation in crystalline form of lipoxydase, etc. Some remarkable results are recorded with pure enzyme and at low temperature. Somewhat earlier Franke and Mönch, with linolenic acid oxidation, had found that the hydrogenated products very probably contained 12- and 16-oxystearic acid.⁴ It should be mentioned that the frequently noted fall in iodine number accompanying oxygen absorption and the initial peroxide formation is not incompatible with the new conception of autoxidation mechanism.

In discussing side and supplementary reactions, the author points out in the first place that the formation of conjugate unsaturated hydroperoxides may be certainly regarded as the primary principal reaction in the autoxidation of linoleic and linolenic acids. The nature and extent of side or supplementary reactions is, however, less certain. Franke and Mönch and Bergström^{5,6} found that, even with relatively low oxygen absorption, higher oxidation products result which, when hydrogenated, yield alpha-glycols to the extent of 20-25 per cent of absorbed oxygen. Among

products isolated were capronic and propionic aldehydes.

Of interest in this connection is the recent observation of Bernheim *et al*⁷ that catalysed oxidation of linolenic (not oleic or linoleic) acid yield an oxy-C₅ substance which responded colorimetrically to the thiobarbituric or p-amino-benzoic acid reaction. It should be mentioned that autoxidation of fatty acids is of profound interest in other fields than that of drying oils, and especially in biochemistry, to which several references are made in the present review. It seems likely, despite recent findings to the contrary, that the formation of this split product must be attributed to a primary ethylene peroxide at the double bond—possibly that most remote from the carboxyl—with lead tetracetate as the splitting agent.

Ketone Formation

Formation of ketones is also discussed in reference to work of Bolland and Koch, Bergström, etc., with absorption measurements and other means. Generally, they may be regarded as being caused by dehydration of the primary hydroperoxide; although, as Lundberg and Chipault have surmised, it may not be the stable peroxide that is involved, but one arising from parallel reaction. Temperature appears to be an important factor here. To date, it seems that only what happens to the first absorbed oxygen molecule is known with any certainty: the fate of the second and subsequent molecules is still obscure. It is likely that these subsequent peroxides are much less stable than the primary compounds. The disappearance of a double bond may be only apparent, and iodine values have to be carefully determined and interpreted.

The mechanism of autoxidation is considered under the three divisions of (a) autoxidation as chain reaction, (b) special cases of radicle formation and conversion, and (c) chain-breaking reactions. The first secured fairly strong support almost from the start, on various grounds including acceleration with light, slowing down or inhibition with anti-oxidants. This later led to the enunciation of the radicle-chain theory of Farmer *et al*, involving removal of a hydrogen atom from an activated CH₂ group, already noted. The formulation of this cycle is shown.

Farmer's ideas were further developed by Bolland and co-workers along kinetic and thermodynamic lines under various conditions. Radicle chains were set free by thermal breakdown of the linoleic hydroperoxide, and on kinetic grounds it seemed that, from each two peroxide molecules

thus broken down, one chain-free radicle was formed and one molecule of water was also set free.

The main question here concerns the primary monovalent dehydrogenation of the fatty acid molecule, involving considerable expenditure of energy (about 80 Kcal/mol). The presence, therefore, of "acceptor" radicles is important, and the idea of a "substratum" peroxide or additional labile peroxide appears feasible, as exemplified in the case of dibenzoyl-peroxide decomposing at higher temperature into the perbenzoyl and phenyl radicles. These radicles may release or weaken the oxidation chain; and this applies to all substances that readily form organic peroxides with oxygen. There is an extensive literature on such catalytic effects.⁸

As to the action of heavy metal driers or siccatives, this has not yet been sufficiently explained. Reference is made to Whitting's formulation of benzaldehyde autoxidation, with metals as hydrogen-acceptors, and to earlier work with ferrous complexes in the biological field, including the possibility (suggested by the author) of secondary activation of fatty acid peroxide molecules. In this connection Robertson and Waters⁹ have distinguished between initial and secondary catalysts in the case of tetralin autoxidation. But it is doubted whether this is really necessary.

The special cases of radicle formation and conversion, including the researches of Farmer and co-workers, and of Bolland and Gee on the reaction of a double bond with oxygen, are briefly discussed. Formulation examples are given of primary reaction stages, stabilisation of a di-radicle as bridge peroxide, formation of six-ring structures, and intramolecular reactions. These examples show how easily polymerisations may be explained on the "radicle" hypothesis.

Chain-Breaking Reactions

Finally, on the subject of chain-breaking reactions, Bolland's work is again the main topic of discussion, and his estimate of chain lengths of 50-100 members in autoxidation of linoleic ethyl ester at 45° is noted¹⁰ together with formulations of chain-breaking reactions and dimerisations. The action of foreign (non-system) substances of a phenol nature and of anti-oxidants is also mentioned briefly.^{11,12} With a formula for inhibitors; or value of v (initial reaction velocity) in terms of the unrestricted autoxidation, linoleic ester and inhibitor concentration, and a constant (k).

(continued at foot of following page)

THE STORY OF CABLES

Round the World in 53.6 Secs.

THE laying of the first submarine cable across the Straits of Dover on August 28, 1850, between Dover and Calais, marked the origin of a new era in international communications and the foundation of a great modern industry which has, from the outset, been almost entirely British.

To mark the centenary of the event a special exhibition "100 Years of Submarine Telegraph Cables" was opened this week at the Science Museum by the Postmaster General, Mr. Ness Edwards. A telegram was transmitted by him which travelled round the world and was received back in 53.6 seconds.

The first cable was laid through the enterprise of Jacob and John Brett, who were not themselves scientists, but the exhibition shows that a large part of the credit for the achievement was due to Charles Hancock, who in 1848 patented a method of coating wire with gutta percha for insulation. This remained the only material used for this purpose until the recent application of polythene proved it to be as good an insulator.

Features of the exhibition include scale models of machinery and of cable-laying ships, and arrangements whereby visitors at certain periods may exchange messages with operators in overseas telegraph stations.

The exhibition adds one more to the series of excellent scientific and technical displays organised by the Science Museum which are of interest not only to the expert but also appeal to the lay visitor.

PRIMARY AUTOXIDATION IN OIL DRYING

(continued from previous page)

This condensed abstract from the German original serves to show that a wealth of material has been contributed in recent years. But there are still many gaps. Recent work has been mainly in the field of ultraviolet spectrography, and this seems to have somewhat slowed down of late (in the opinion of Franke).

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PEST CONTROL PRODUCTS

First List of Simple Names

AT the beginning of this year, the British Standards Institution made the widespread announcement in the technical and trade Press (THE CHEMICAL AGE, 62, 257) that a technical committee had been appointed to devise simple, common names for well-established pest control products, including insecticides, insect repellents, acaricides, nematocides, fungicides, herbicides and rodenticides. The need for common names which do not conflict with proprietary names was pointed out on account of the considerable confusion which has arisen in commercial descriptions and in the technical literature.

The B.S.I. now announces that this technical committee has prepared the first list, containing some 25 common names for the better-known products now in general use in agricultural and in veterinary circles throughout the country. This list is being circulated for technical comment among Government departments, manufacturers and the interested scientific societies before final publication. In order to pre-empt the use of these names as proprietary names, the list has been lodged with, and approved by, H.M. Patent Office. The names will be given protection and will be referred to when application is made for the registration of proprietary names for pest control products.

U.S. Concurrence

Wherever possible the names adopted conform with those already accepted as coined common names by the U.S. Department of Agriculture, and the same system of protection is given by the U.S. Patent Office. It is hoped that the same measures will extend to other countries in due course.

The chemical names assigned to each compound are in accordance with the principles recommended by the Chemical Society. Where possible, only the pure active ingredients have had common names assigned to them, and an endeavour has been made to avoid, with a few outstanding exceptions, the use of initials and numbers. The exceptions are made in the cases of compounds which are already well known by initials, such as DDT and BHC, since a further name would only increase the confusion.

During the drafting, the technical committee has maintained liaison with the Commonwealth countries as well as with the appropriate committee in the U.S.A.

The Progress of Chemistry

Trends Surveyed by the Chemical Society

THE annual report on the progress of chemistry during the year 1949, has been published by the Chemical Society. This year the report is divided into six sections: General and physical chemistry, crystallography, inorganic, organic, analytical and bio-chemistry.

In previous years the aim has been to give a comprehensive survey of work carried out over a period of years in selected topics. The policy will now be to give a general perspective of the main developments during the year under review. The papers in this report have been preferentially selected so as to be of interest to chemists outside the immediate circle of specialists. The general plan is to give an account of trends in the various branches of chemistry, and the treatment of individual topics is more by reference and is less self-contained than in previous years.

A Time Lag

Because of the decision to change the scope of the report this 1949 publication marks a transition stage and there is a certain time-indeterminacy, aggravated by the fact that some war-time European papers have only recently become available to British workers. Generally speaking, however, the report contains topics from publications abstracted between August, 1948, and July, 1949, inclusive, though it is not wholly restricted to that period. Of the twelve topics dealt with under the heading of "General and physical chemistry" no fewer than ten are contributed by A. R. Ubbelohde. They include "General Thermodynamics and the Evaluation of Thermodynamical Functions for Gases," "Isotope Chemistry," "Bond Structure and Bond Properties," "The Structure and Properties of Liquids," "The Physical Chemistry of Liquid and Solid Dielectrics," "The Physical Chemistry of the Solid State," "Adsorption and Surface Chemistry," "Electro-chemistry and Ionic Chemistry," "Kinetic Studies. Photo-reactions and Auto-oxidation," and "The Physical Chemistry of Macro-Molecules." The other two topics in this section are "Magnetochemistry," by R. C. Pink, and "Metals and Alloys. The Pauling Hypothesis," by W. Hume-Rothery.

The section on crystallography is divided into three parts, an introduction and "Crystal Chemistry," by D. C. Hodg-

kin and "The Technique of Structure Analysis," by G. J. Pitt. The introduction deals with the work being done in this field and the heightening interest shown in crystallography, as instanced by the formation of the International Union of Crystallography and the publication by this union of a new journal for crystallographic papers, *Acta Crystallographica*. Because no formal report on crystallography has appeared since 1946, this 1949 report covers the three years 1947, 1948 and 1949.

Twenty-eight pages of the Report are devoted to the subject of inorganic chemistry, and the topics are discussed under the eight groups of the periodic table. Copper and its compounds in group 1, boron in group 3, hydrogen peroxide in group 6 and fluorine in group 7 are the subjects in which the major proportion of work has been done. The survey is presented by R. E. Dodd and P. L. Robinson.

The organic chemistry section does not attempt to give a true annual report but instead deals with important topics not reviewed for some time. The section is divided into eight parts, including an introduction, which are as follows: "Theoretical Organic Chemistry," by E. A. Brande, "General Methods," "Alkaloids" and "Vitamin A and Related Polythienes" by A. W. Johnson, "Long-chain Aliphatic Compounds" by R. E. Bowman, "Amino-acids," by H. N. Rydon, and "Proteins" by M. V. Tracey.

Significant Advances

Biochemistry comprises two parts devoted to "Haemopoietic Factors" by W. F. J. Cuthbertson and "Carotenoids, Vitamin A and Visual Pigments" by R. A. Morton. C. Rimington, in his introduction to this branch of chemistry, considers that "very significant advances have been achieved during 1949."

The last section, on analytical chemistry, consists of seven parts. The introduction, "Gravimetric Analysis" and "Organic Reagents in Inorganic Analysis" are by H. Irving, "Radioactivation Analysis" and "Gas Analysis" are contributed by A. A. Smale, and the other two parts are "Analytical Applications of the Raman Effect" by L. A. Woodward and "Analysis of Organic Compounds" by G. Ingram and W. A. Waters.

NEW PROCESS FOR SULPHUR PRODUCTION

British Survey of Desert Lakes

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Two scientists from the Chemical Research Laboratory, DSIR, have recently completed a survey of lakes in Libya in connection with the research. These desert lakes are full of micro-organisms known as sulphate reducing bacteria which reduce sulphates to sulphides. Sulphur can be produced from hydrogen sulphide by simple aeration. The rate of production of sulphide is low and to make the process economically feasible it is necessary to speed up the reduction of sulphates to about ten times its normal rate. The research has this object in view.

Three methods of research will be used. Strains of bacteria from various parts of the world will be examined for their speed of reduction, the influence of different environment will be investigated and methods of obtaining possible quick reducing strains by artificial means will be explored. The sulphate reducing bacteria were originally studied in detail in this country because of their corrosive action on buried pipes.

The two scientists engaged on this research, Mr. K. R. Butlin and Mr. J. Postgate, have been examining lakes in Tripolitania and Cyrenaica. From a report received in 1949 it seemed likely that sulphur was being produced in these lakes in fair quantity by biological processes and that an examination of them would yield information and cultures of scientific interest.

A "Desert Laboratory"

Accompanied by Arabs, who drove the trucks and cooked, Butlin and Postgate visited several lakes near El Agheila. They were in the desert for a week and took with them a special "desert laboratory" which had been designed and made in the CRL workshops.

Four lakes were examined, and samples taken for later work at the CRL. The scientists found that the first lake they saw was striking in colour. It was a vivid milky blue with a broad band of red round its borders. The Arabs plunged into the lake and scooped up handfuls of yellow mud. It was sulphur.

There was a strong smell of hydrogen sulphide, more familiar to most people as "sulphuretted hydrogen," which is an

indication of the action of sulphate reducing bacteria. The red colour of the lake was due to a carpet of gelatinous material which lay on the bed of the lake in shallow water. It was red on the top and black and green underneath.

A well washed sample was examined later at the CRL and found to consist mainly of pink cells. This is probably a species of organism which produces sulphur from the sulphide in the presence of light and deposits it *inside* the cell. The green colour was produced by other organisms which rapidly oxidise sulphide to sulphur and deposit it *outside* the cell. The bottom of the lake, it was found, was covered with a deposit of about six inches thick of finely divided sulphur.

This formation of sulphur has since been reproduced in the laboratory by inoculating an artificial lake water, based on an analysis of the original, with the red and green material and crude cultures of sulphate reducers. Much sulphur was formed.

Sulphate Reducers

Two other lakes examined were similar to the first. The fourth had the smell of hydrogen sulphide and was obviously full of sulphate reducers. It was not however producing much free sulphur and it did not have the red border characteristics of the other lakes.

An industrial process based on what takes place in the lake, may well be developed. One small lake contains about half a million gallons and produces about 100 tons of sulphur a year.

Sewage is an excellent medium for sulphate reducers and it might be possible to contaminate lakes in desert areas to facilitate large scale production of sulphur. This is, of course, a highly speculative idea, but it could be tested easily enough.

At present the samples brought back from the desert are being examined and different types of organism isolated. When pure cultures of the sulphate reducing bacteria and of the sulphide oxidising organisms are obtained it will be possible to examine their properties and to make experiments on the production of sulphur in various conditions, in different media and to use solid surfaces such as asbestos and coke to see what effect they have on speeding up the process. It may also be possible to develop artificially highly active strains of bacteria.

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Metallurgical Section

2 September 1950

COBALT AND NICKEL-PHOSPHORUS ALLOYS

High Phosphorus Content Confers Commercial Advantages

A COMMERCIALLY feasible method for producing electrodeposits of cobalt or nickel alloyed with as much as 15 per cent of phosphorus has recently been developed by Abner Brenner, Dwight E. Couch, and Eugenia K. Williams of the U.S. National Bureau of Standards. The new phosphorus alloys are more easily deposited than chromium and are very hard, corrosion-resistant, and bright. They should thus be of value for many of the applications in which chromium plate is now used to obtain a hard, wear-resistant surface or a decorative finish.

Bath Conditions

Plating baths for depositing the phosphorus alloys are simply prepared, consisting of common nickel or cobalt salts, such as the sulphate or chloride, to which is added phosphoric acid as a source of phosphorus in the deposit. The baths are operated at a low pH—between 0.5 and 1.5 depending on the composition. To maintain the desired acidity in the cathode film, the solution must be buffered. The bureau has found phosphoric acid to be one of the best chemicals for this purpose.

The plating baths are kept at 75° C. or above because at room temperature the cathode current efficiency is very low and the deposits are weak. Current densities should be between 5 and 40 amp. per square decimeter. At the usual current density—about 10 amp. per square decimeter—the rate of deposition is fairly high, amounting to a few thousandths of an inch per hour.

The appearance of the deposits depends upon their phosphorus content. Alloys with less than 2 per cent of phosphorus are usually smooth with a matt finish; but as the percentage of phosphorus increases, they become brighter, reaching a peak of brightness at a phosphorus content of about 10 per cent. When such deposits are plated on a dull surface, they increase in brightness as they become thicker. As a result of the slightly dark cast of the

high-phosphorus alloys, their reflectivity is 45 to 50 per cent, compared with about 60 per cent for buffed nickel coatings.

When some of the phosphorus alloys are immersed momentarily in a solution of an oxidising agent such as ferric chloride, or made the anodes in the plating bath, a jet black film is formed on the surface of the metal. This film is hard and adherent and appears to have possibilities for decorative use.

Photomicrographs of the low-phosphorus alloys show a columnar structure while the high-phosphorus alloys are found to have a laminated or banded structure. X-ray diffraction pattern of the high-phosphorus alloys shows no crystalline structure. When heat-treated, the deposits develop a fine-grained structure instead of the large crystals characteristic of pure nickel or cobalt.

Heightened Acid Resistance

The hardness of the deposits as plated varies from 50 to 720 on the Vickers scale, and increases with phosphorus content. When the alloys are heat-treated at 400° C., they become much harder. For example, a heat-treated cobalt-phosphorus deposit containing about 10 per cent of phosphorus reaches a hardness of over 1100 Vickers, which is greater than that of electro-deposited chromium.

Deposits which have been raised to 800° C. and cooled are not appreciably softer than the initial deposit. However, the alloys have poor "hot hardness" and above a temperature of 600° C. are softer than unalloyed nickel or cobalt.

Although the low-phosphorus alloys become ductile after heat treatment at 800° C., deposits containing more than 1 per cent of phosphorus are generally brittle. Alloys with higher percentages of phosphorus are highly resistant to corrosion and chemical attack, exceeding in this respect the pure metals. Thus, in experiments at the bureau the nickel alloy with 10 to 14 per cent of phosphorus

was attacked considerably less by hydrochloric acid than was pure nickel.

The pleasing appearance, ease of deposi-

power of the plating bath should be of considerable advantage.

Although the phosphorus alloys are not

COMPOSITION OF TYPICAL PLATING BATH FOR DEPOSITING ALLOYS OF PHOSPHORUS WITH COBALT OR NICKEL

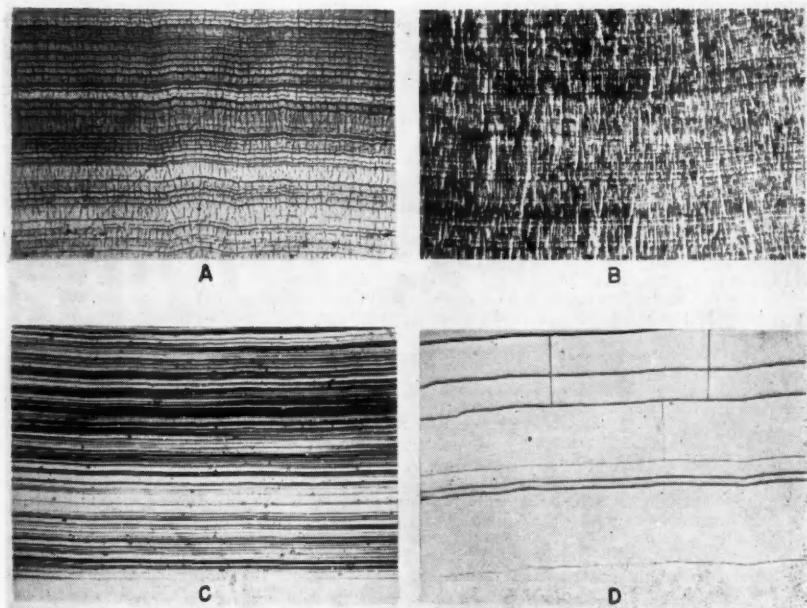
Type of Bath*	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (g/l)	$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ (g/l)	H_3PO_4 (100%) (g/l)	H_3PO_2 (100%) (g/l)	$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ (g/l)
Low-phosphorus nickel	...	175	50	50	1.3
High-phosphorus nickel†	...	150	45	50	40
Low-phosphorus cobalt	—	50	1.3
High-phosphorus cobalt†	—	50	40
					210
					180

* It is important that the pH of the bath should be less than 1.0.

† The pH of the high-phosphorus bath should be raised to a value between 0.5 and 1.0 by adding nickel or cobalt carbonate.

tion, hardness, and corrosion resistance of the new alloys suggest the possibility of a number of commercial applications. Their use is indicated for gauges, cylinder walls, piston rings, and other machine parts where resistance to wear is an important factor. In this connection, the more rapid rate of deposition as compared with chromium and the better throwing

as white as bright nickel, the operation of the baths is much less critical than for proprietary bright nickel. The phosphorus alloys can be plated from a bath made up entirely of inorganic chemicals whereas bright-nickel plating solutions must contain an organic brightening agent.



Photomicrographs of electrodeposited alloys of phosphorus with cobalt and nickel, showing the distinguishing characteristics. Phosphorus alloys show columnar structure; high-phosphorus alloys have a laminated structure. A. Low-phosphorus nickel (2.8 per cent P); B. Low-phosphorus cobalt (2.2 per cent P); C. High-phosphorus nickel (18 per cent P); D. High-phosphorus cobalt (10 per cent). Magnification $\times 275$.

CHOICE OF ALUMINIUM ALLOYS

Procedures to be Adopted in Testing

ALTHOUGH a very wide variety of alloys has in the past been used for the manufacture of aluminium castings, the recent tendency has been to reduce the number in current use, and, indeed, the bulk of present-day foundry production is effected using less than half a dozen different materials. The correct choice of alloy to be used in any given case depends on an appreciation of the various requirements imposed by the conditions of service, and these demands are, of course, not always compatible.

Probably the most important properties governing the selection of a suitable alloy are the mechanical properties and corrosion resistance required, while the behaviour of the alloys in the foundry must also be taken into account.

Designers should co-operate with the foundryman in making decisions about the material to be used, and if there is any possibility that large quantities, justifying the use of gravity or pressure die-casting, will eventually be required, prototype castings should be designed in such a manner as to facilitate this change.

The factors which influence the choice of a casting alloy for any given application include the following, which may be regarded as being the most important:

Strength and ductility requirements.

Foundry characteristics, including fluidity and freedom from cracking under the influence of solidification stresses.

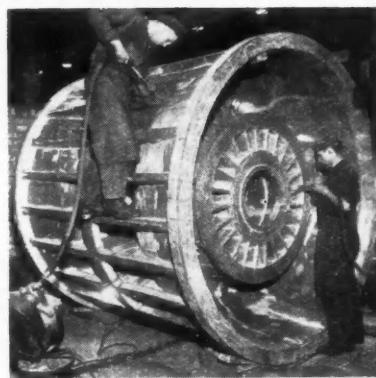
Resistance to attack by specific chemicals.

Evaluation of Properties

The properties of other than the tensile values so far discussed—resistance to hot-tearing, the reduction of strength due to porosity, and leakage under pressure—relate to the behaviour of the alloys during solidification. Full consideration must also be given to such properties as corrosion resistance and ease of machining.

Most aluminium-alloy castings are put into service without any protective surface treatment such as painting, anodising or electroplating; but in some applications such as finishes are necessary, and this may be a further factor influencing choice of alloy.

The choice of the casting process to be



By courtesy of the Birmingham Aluminium Casting Co., Ltd.

Rotary vacuum filter drum, in course of manufacture, cast in aluminium alloy LM-4 constituting one of the largest aluminium sand castings ever produced in this country. Overall dimensions are 7 ft. 8 in. diameter by 6 ft. 10½ in., and the finished weight is approximately 8 tons. This necessitated the pouring of some 6 tons of metal and the use of 51½ tons of sand for the moulds and cores

used depends to a considerable extent on the numbers required, die-casting (either gravity or pressure) becoming economic when runs of the order of thousands off are called for. Some limitation on alloy choice is, however, set by the nature of the process used, for while all foundry alloys may be satisfactorily cast in sand, fewer are suitable for gravity die-casting and fewer still for pressure die-casting.

Aluminium casting alloys fall into two principal divisions, according to whether or not they respond to heat-treatment. Those which are put into service without heat-treatment normally give tensile strengths of the order of 9 to 11 tons/in.² in sand castings, with somewhat higher figures for gravity and pressure die-castings.

Fully heat-treated alloys, on the other hand, show a much higher tensile strength, values of 18 tons/in.² being reached with certain alloys for sand castings and 20 tons/in.² or more for gravity die-castings.

* This article is an abstract from "Aluminium Alloy Castings" published by the Aluminium Development Association, 33 Grosvenor Street, London, W.1.

The high strengths just given are developed by a double heat-treatment, consisting of solution treatment at above 400° C. followed by quenching and precipitation treatment at about 170° C. Certain alloys, such as LM7-P, receive the latter treatment only.

There is naturally a preference on grounds of cost and convenience for the alloys which do not require heat-treatment. For most general engineering applications the mechanical properties of the non-heat-treatable alloys are adequate.

It should be realised that the values given for the tensile properties specified in B.S. 1490 may not always be reached in every part of a casting; they are actually determined on test bars which solidify under conditions giving the maximum possible soundness. In practical castings used for engineering purposes lower values are unavoidable in certain regions, principally where the section is thicker than in the surrounding parts.

Solidification Shrinkage

This reduction of strength is due essentially to the contraction which molten aluminium, in common with other metals, undergoes on passing from the liquid to the solid state. As a result, porosity due to uncompensated solidification shrinkage is liable to occur in the parts which freeze last, i.e., those of heavier section. Much can be done to minimise this loss of strength by placing suitable feeders or risers at such points or by hastening their solidification by the use of chills.

Where design includes thin sections, and particularly if their area is extensive, some difficulty may be experienced in completely filling the mould. Using test castings of special form in which the alloy is allowed to run into a long, thin channel, it has been possible to grade the alloys in order of their fluidity or mould-filling properties.

Broadly speaking, the conclusion is that there is little difference between the various alloys at equal temperature intervals above the temperature at which they begin to solidify (the liquidus). The eutectic aluminium-silicon alloys have a lower liquidus temperature than solid-solution alloys containing copper, magnesium, etc., and at a fixed pouring temperature they are therefore the most fluid; accordingly they are much used in producing castings with extensive areas of thin section.

The reduction in strength in heavy sections is one aspect of a series of qualities referred to as the casting characteristics of the alloys. In certain materials cracks may be formed if free contraction is restrained by the prior solidification of parts

of complex castings, and particularly where cores are used.

Experimental work and the experience of founders now make it possible to classify the alloys in relation to this defect. At this point, however, it may be emphasised that the aluminium-silicon alloys such as LM6 and LM9 and the aluminium-silicon-copper alloy LM4 are the least susceptible to the trouble.

Many castings are required to withstand liquids or gases under pressure, and in such cases any form of leakage is inadmissible. Careful attention to design will help to avoid such leakage, but it should be recognised that the several casting alloys differ considerably in this respect. In some cases, and notably where there is a more or less extended freezing range, the porosity caused by solidification shrinkage forms an interconnecting network through which gases and liquids can percolate.

There are other alloys in which the porosity takes the form of small rounded cavities isolated from each other, and in this type of material—typified by the aluminium-silicon eutectics, including LM6 and 9—a moderate amount of porosity may be tolerated, since it does not lead to leakage under pressure.

Compared with most other metals, aluminium alloys have a high durability owing to the natural oxide film present on their surface; there are, however, differences as between the different foundry alloys, and it should be emphasised that alloys not conforming to recognised standards of composition cannot be relied upon. The binary aluminium-silicon alloys have corrosion resistance in marked degree, while the presence of copper reduces this property.

In the manufacture of cast cooking utensils the material used is often an aluminium-5 per cent silicon alloy. Aluminium-magnesium alloys such as LM5 and 10 are also very suitable for applications in which marked corrosion resistance is required. This is particularly true where chloride attack is involved, as in marine service.

Anodising

Added protection against corrosion is sometimes afforded by thickening the natural oxide film by anodising, an electrical process in which the work is made the anode in a solution, generally of sulphuric or chromic acid. A somewhat similar effect to that produced by anodising may also be achieved by chemical treatments in which the work is immersed in solutions of alkali-metal salts (such as chromates and carbonates) without the application of electricity.

Anodising tends to emphasise surface

irregularities, and, on pressure die-castings, may even reveal flow lines which have been masked by polishing. The best anodised effects are obtained on gravity die-castings of suitable composition. Alloy composition has considerable bearing: for example, the high-silicon grades tend to give somewhat dark finishes, while the aluminium-magnesium LM5, aluminium-silicon-copper alloy LM4, and the complex alloy LM7 give a lighter and more uniform surface appearance.

Electroplating requires a clear and uniform surface, and gravity die-castings are the most suitable. Freedom from internal porosity is also an important requirement of castings that may be heated in service. Alloy composition does not limit the choice of metals that can be plated on to aluminium, but does affect the type of pretreatment.

For both anodising and plating, sand castings are the least suitable.

The rise of the aluminium foundry industry owes much to the requirements of aircraft constructors, and their exacting standards of quality have necessitated searching inspection procedures. For this reason aluminium-alloy founders have built up inspection departments unsurpassed by any other section of the foundry industry, and the possession of such facilities, coupled with the skill and experience gained during many years, is an asset of great value to users.

Test bars for tensile testing are often cast from each melt poured in the foundry. In aluminium-alloy practice the DTD-type bar is used, and this, in common with other test bars, is designed so as to give maximum soundness. The tensile properties found in the test bar are an indication of the quality of the metal poured and of the success of any heat-treatment applied rather than of the strength of the castings themselves.

Check by X-ray

X-ray examination is widely practised to detect unsoundness and inclusions. The proportion of castings thus inspected varies with the importance of their service function, and the method is often used in developing techniques for new designs of casting. X-ray examination is supplemented from time to time by sectioning the regions of suspected unsoundness. The use of X-rays, in addition to being a valuable check during production, is often of great value at an earlier stage establishing the most effective casting technique for a given design.

The methods of fluorescent crack detection are applied to ensure the absence of

superficial cracks and unsoundness. The casting is immersed in a bath of fluorescent liquid, washed in carbon tetrachloride and then examined in ultra-violet light. Unsound or cracked areas then appear bright green against a dark background.

The French chalk test is similar to the fluorescent crack detection test in purpose but requires less-specialised apparatus. The castings to be tested are immersed for 15-30 minutes in a bath of oil held at about 90° C. They are then removed, and excess oil is removed from the surfaces, which are then dusted with fresh chalk. On cooling, surface unsoundness and cracking are revealed by the exudation of the oil, which darkens the chalk locally.

In many foundries provision is made for crushing sample castings to destruction so as to reveal any areas of weakness. This type of test is of great value during the development stages of a new design and as an occasional check during production.

Highly stressed castings are sometimes subjected to tests in which loads are applied to simulate as far as possible the actual conditions of service, the deflections at selected points being measured under the applied loads. In certain factories and testing departments there are facilities for making fatigue tests on complete castings.

Castings required to resist pressure, whether of liquids or gases, are tested for freedom from leakage. Such testing is normally carried out using compressed air or nitrogen at a pressure of 30-50 p.s.i. Leakage is revealed by immersing the castings under pressure in oil or water.

Water for Atomic Station

The Rivers Dee and Clwyd Catchments Board has approved a draft agreement allowing the West Cheshire Water Board to take from the Dee at Chester water not exceeding five million gallons a day for use at the atomic research station at Capenhurst, Wirral.

"LION BRAND"

METALS AND ALLOYS

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ESTABLISHED 1869

Trade Journal Publishing

Printing and Paper Frustrations

THE outstanding event of the year was the ending of paper rationing for periodicals. Thus, during the period we are met to discuss, healthy competition returned. To the planners, that was doubtless regarded as a retrograde move—a reversion to what they would call the law of the jungle," said Mr. E. Glanvill Benn, chairman, at the recent 54th annual general meeting of Benn Brothers, Ltd., publishers of *THE CHEMICAL AGE* and associated journals. "To my mind, however, the familiar cliché, 'the law of the jungle,' is entirely false and misleading as applied to modern competitive business. The boxing ring provides a more accurate analogy."

Restricting Rules

On all sides the business classes were restricted by rules and regulations at least as severe as the Marquess of Queensberry's, and in place of a referee and judges there were auditors, trade union officials and Government inspectors to watch every move, and every move was made in broad daylight, said the chairman. The winner in the boxing ring usually earned applause and a cup. The winner in the trade ring was often reviled by those who should be most grateful to him and the larger part of any silver he might earn was taken away from him.

The analogy must not be pressed too hard, but it was certainly closer to reality than the fanciful notion of a brutish tiger of a capitalist creeping silently through the dark jungle and pouncing on terrified innocents, or tearing at a more robust rival, tooth and claw, until one of them bled to death.

Like the boxer, the business man in a competitive world must keep himself trained and fit. The return to competitive conditions in the trade Press field found the company's journals in excellent trim. After nine months in the free ring their trainers reported with confidence that each journal was relatively stronger than ever. That strength was the testimony, if any were needed, to recognition in the great industries and trades the company's journals served, of the importance and value of an independent trade Press that was vigorous and free and untrammelled by the conditions and restrictions imposed by subsidies and controls on "kept" journals.

As for prospects in the coming year, the outlook was somewhat clouded at the moment by the prolongation of the ban on overtime imposed by the London Society of Compositors, with all its damaging consequences for trade and other periodicals. It was sad to reflect that barely had paper, the raw material of the publishing industry, been freed from rationing and control before another frustration made itself felt, and that through harsh action by a body of men in the printing industry, which had so often been held up as an exemplar in the matter of harmony in industrial relations. The overtime ban had already been in operation for 14 weeks.

The profit-earning powers of the business remained healthy. Revenues were higher than ever, but operating expenses, particularly costs of printing and paper, rose steeply, leaving a smaller margin of profit than a year ago.

Reserves

It would be misleading, however, to appear pessimistic. The year's profit once again enabled the directors to make large additions to the company's massive accumulated reserves and to pay the same rates of dividend as before.

The visible reserves now exceeded the paid-up capital by more than £30,000. Goodwill and copyrights stood at the nominal written-down value of £100,000. That was the same figure as two years ago, in spite of the important additions made to the company's long list of publications in that time. In other words, the company paid for those additions out of current profits, or reserves previously earmarked for just that purpose.

OCCA Exhibition

THE presentation of technical advances in those industries which supply paint, varnish, printing ink, linoleum and other related manufactures will be the theme of the third technical trade exhibition to be staged by the London section of the Oil and Colour Chemists' Association, on March 19, 20 and 21, 1951, at the Borough Polytechnic, London. It is intended to extend invitations to the exhibition, not only to all OCCA members, but as far as possible to all consuming firms in Britain and many overseas countries.

OVERSEAS CHEMISTRY AND INDUSTRY

INDIA'S CONTINUED EXPANSION

Some Further Self-Sufficiency Pointers

FURTHER references to India's aim to be self-sufficient in salt and a number of other products were made recently in the New Delhi Parliament by Mr. H. K. Mahatab, minister of industry and supply. For example, he said the manufacture of salt as a cottage industry has considerably developed in Orissa. About 1 million maunds of salt, calculated to be about half the requirements of the State were now coming from this source. The newly formed salt manufacturers' association is urging the Government to continue to restrict salt imports in the interests of the home producers.

India will export about 700,000 tons of manganese ore during 1950, of which the largest importer will be the U.S.A.—500,000 tons. India's export last year was approximately 500,000 tons.

Mr. K. M. Munshi, India's Food Minister, in a written reply in the Union Parliament, New Delhi, said that a total quantity of 372,673 tons of fertilisers, valued at Rs. 111,946,065 was imported in the seven months ending July 31, 1950, into India.

Mr. H. K. Mahatab said that the Sindri fertiliser factory was likely to go into full production about August next year.

The Indian Tariff Board holds that there is no case for protection of the liver extract industry in India, the fair prices of the indigenous products being appreciably below the landed cost of comparable imports. The Government of India has accepted the Board's recommendation.

Imports

The Board further stated that licences for imports of vitamins for liver extract compounds should be liberally granted.

The Government of India has also put on open general licence a number of articles required for indigenous purposes and certain types of essential consumer goods including textile chemicals, mercury and tallow.

Oil has been struck in the Patharia reserve forest area in Cachar district on the East Bengal-Assam border. A production of about 500,000 tons of oil is expected in the next two years.

The Central Glass and Ceramic Research Institute of India, at Jadavpur, the

fourth in the chain of 11 national laboratories, was opened on August 19.

Plastic manufacturers in India have now taken up the manufacture of artificial plastic eyes from acrylic plastic and it is stated that the annual demand of the Ministry for about 150 eyes can be met by indigenous production.

Production of plastics goods in India has risen from 370,000 lb. in 1948 to 1,048,000 lb. in 1949. There are today about 200 compression moulding presses, 120 injection moulding machines and 40 extruders installed in India.

Bauxite Scheme in Jamaica

CONSTRUCTION of plant having a production capacity of about 40,000 tons of aluminium oxide (semi-processed bauxite) annually is being planned by Jamaica Bauxites, a wholly-owned subsidiary of Aluminium, Ltd., of Canada.

Funds will be advanced by the Economic Co-operation Administration (Marshall Plan) amounting to \$2.5 million and \$1.5 million. This is the second contract signed by the ECA for the mining of bauxite in the British West Indies.

Ordering of equipment and detailed engineering planning for the project will begin at once and a large proportion of equipment will be ordered from U.K. sources. The scheme is expected to be completed by the end of 1953.

This enterprise had been under consideration since 1942 just after the discovery of bauxite in Jamaica, said Mr. Nathanael V. Davis, president of Aluminium, Ltd. Some \$3.4 million (Canadian) had been invested in acquiring about 30,000 acres of land in the island, and in research and development.

After a study of the special nature of Jamaican ores and the economics of their ocean transportation, it had been decided not only to undertake bauxite mining, but also extraction of aluminium oxide, through the construction of a plant capable of producing 100 tons of oxide a day.

When the initial stage of the oxide plant is completed, total investments of Aluminium, Ltd., in Jamaica, will amount to about £12 m., including agricultural operations.



The Chemist's Bookshelf

THE CHEMISTRY OF THE ACETYLENE COMPOUNDS. Vol. 2, The Acetylenic Acids. A. W. Johnson. 1950. Edward Arnold & Co. Pp. 328. 50s.

This is the second volume by Dr. Johnson on the chemistry of acetylenic compounds; the first, which was published in 1946, dealt with the acetylenic alcohols.

The book is divided into four parts, of which the two largest are devoted to the acetylenic monocarboxylic acids and the acetylenic polycarboxylic acids. The two remaining parts deal with the polyacetylenic carboxylic acids and the acetylenic non-carboxylic acids respectively. The author has followed his previous practice of organising his subject matter and the three main parts of the book are subdivided as follows: historical, natural occurrence, nomenclature, methods of formation, physical properties, reactions involving the carboxyl group, reactions involving the triple bonds, reactions involving the free ethynil group and, finally, reactions involving the whole molecule.

The main text covers the entire literature up to the end of 1948 and there are upwards of 1500 references. Two appendices are included. One of these deals with the available literature published during 1949 and thus brings the book as up to date as possible under the present somewhat adverse publishing conditions. The other appendix is a table of the chief physical constants of the known acetylenic acids, together with literature references as to the best methods of preparation, and listed according to the system of Richter's "Lexikon der Kohlenstoff-Verbindungen."

As the author observes in his preface, "the acetylenic acids . . . are of considerable importance in synthetic organic chemistry" and for chemists engaged on such work this book is a most valuable addition to their literature. Dr. Johnson appears to have made every endeavour to ensure accuracy and there is reason to believe that his book will prove to be a standard work on the subject. Despite the considerable advances still being made in the chemistry of the acetylenic acids, it seems reasonable to expect that this volume should not become out of date

for a long time to come. One might perhaps have expected a rather more critical presentation, although in this respect the author may have found himself limited for space, and have cut his matter accordingly.

Altogether, a splendid book.—P.M.

AN OUTLINE OF SCIENTIFIC CRIMINOLOGY. Nigel Moorland. 1950, London. Cassell & Co., Ltd. Pp. 284. 12s. 6d.

Few except specialists—and they are not numerous in this field—have the leisure to consider the little known branch of science concerned with the detection of crime and criminals. Here is a very knowledgeable and comprehensive survey of all the numerous forms of applied science now being used in establishing facts before the law, of which occasional glimpses are given in the published reports of trials. Here the multiplicity of techniques, ranging from anatomy and medicine to metallography and ballistics, microscopy, photography, and forensic chemistry which police departments can call upon are given much fuller treatment. This with the many actual examples cited makes a narrative very much more compelling than the average "thriller." The author does not disguise his discontent that both France—in this regard a pioneer—and the U.S.A. have left this country far behind in the creation and use of forensic science departments. His whole narrative, however, proves beyond doubt how successful have been the improvisations here, because of a readiness of experts in all branches of science to make all their skill and knowledge available whenever the ends of justice require them.

Books Received

QUANTITATIVE MICROANALYSIS. P. L. Kirk. 1950, New York: John Wiley & Sons, Inc. London: Chapman & Hall. Pp. vii + 310. \$5.00.

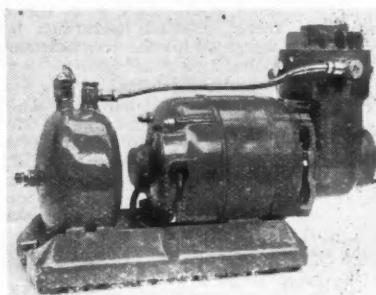
FRictional PHENOMENA. Andrew Gemant. 1950 Chemical Publishing Co., Inc. New York. Pp. xi + 497. \$12.00.

Technical News and Services

PUMPING 20 tons of molten zinc between buildings 50 ft. apart—a job which, done by hand, would have taken eight men a whole day—was completed in 20 minutes by means of an electrically driven centrifugal pump, designed by Mr. Paul M. R. Bower, a director of Barnards, Ltd., wire netting manufacturers, Norwich. The firm says this is probably the first time such an operation with molten zinc has been carried out successfully in this country. This is one of the productivity items recorded in the current issue of *Target*, issued monthly by the Economic Information Unit of the Central Office of Information.

LEATHER in Germany during the war is the subject of a BIOS survey, number 27, which has just been published. It contains over 100 reports which cover many aspects of leather processing and manufacture. Two new tannages evolved during the war are described—the sulphonyl chloride and the di-isocyanate methods. The arrangement of the survey is encyclopedic and there is a comprehensive index of subject matter, together with a list of the tanneries and chemical plants visited by the investigators. The survey is called "The Leather Manufacturers and Related Industries in Germany during the period 1939-1945."

THE development of the pipeline method of transporting crude petroleum and the construction and operation of a modern pipeline are reviewed in an illustrated article in the August issue of the *Edgar Allen News*.



[By courtesy of the Hymatic Engineering Co., Ltd.]

A new design of diaphragm type compressor to provide air completely free from oil and other impurities. It is particularly suited for food processing, medical and industrial laboratories, raising liquids which must not be contaminated, insecticide and pest control spraying, or spray painting. The compressor crank-case and cylinder head are of aluminium alloy, the head being finned for effective cooling

ANTWERP'S new oil refinery being constructed by the Anglo-Iranian Oil Company and the Belgian group Petrofina is expected to be completed by 1951. A description of the project and an artist's coloured impression of the refinery as it will ultimately look, are given in "Naft" (August, Vol. 26, No. 4) published by the Anglo-Iranian Oil Co., Ltd. The nominal capacity of the refinery is 1.32 million tons of crude a year, and main items of process plant will be: crude distillation unit; vis-breaker and thermal cracking unit; reformer; redistillation unit; cracked P.D. acid treating plant; kerosene acid batch washer and copper chloride treaters.



One of 12 special demountable tanks, recently completed for British Railways, to convey sodium silicate. Each is of 875 gal. capacity. They have a working pressure of 40 p.s.i. and are provided with a heating coil tested to withstand a pressure of 150 p.s.i.

A NEW bonding technique for the production of steel-shafted badminton racquets is described in "Aero Research Technical Notes" (Bulletin 92, August 1950), now available from the technical service department, Aero Research, Ltd., Duxford, Cambridge. It is claimed that the process provides greater strength with less weight, while the adhesives used are unaffected by mould, fungi, moisture, and are even able to withstand the effects of boiling water without deterioration.

OVERSEAS NEWS ITEMS

Haifa Refineries Reopened

Reports from Haifa state that the oil refineries there resumed operations last Monday (August 28) for the first time since they were closed two years ago.

Arctic Steel Mill

The Government-owned company which is building a large new steel mill at Mo i Rana, North Norway, confirms that the British firm of Davy and United Engineering Co., Ltd., Sheffield, has secured a contract for supplying equipment to the mill. The contract is said to be worth more than £1 million, states the bulletin of the Royal Norwegian Information Service in London.

Swiss Chemical Exports

Official Swiss export trade returns for July show a total value for chemicals, pharmaceuticals, dyes and perfumery of Fr.44.5 million compared with Fr.40.6 million in the previous month. Pharmaceutical products again occupy the leading position with (in million Swiss francs) 20.3 (18.0), followed by dyes 16.2 (14.1). Exports of industrial chemicals declined slightly from 6.5 million in June to 5.9 in July, and perfumery remained unchanged at 2.0.

Synthetic Fibres May Oust Wool

The probability of synthetic fibres replacing wool was expressed recently by Professor T. G. Hunter, professor of chemical engineering at Sydney University in an article in the *Sydney Morning Herald*. The professor specifically referred to a synthetic called vicara made from zein, a protein extracted from corn.

Rubber Seed Oil as Insecticide

Rubber seed oil, experimentally extracted at the rubber laboratory as a base for paints, is now being tested for wider applications according to Dr. A. Sundaralingam, rubber technologist to the Ceylon Government. The Ceylon Medical Research Institute has found the oil an effective prophylactic against the common house-fly.

Austrian Laboratory Glassware

The Oesterreichische Labor-Glas, GmbH, Koeflach, Styria, has begun the manufacture of a wide range of glassware for laboratory and technical purposes, the products being, it is claimed, equal in quality to the best foreign makes. It is expected that this project will save the country large sums in foreign exchange and that it may eventually be possible to export glassware. Until quite recently Austria had been entirely dependent upon imported laboratory and other high-grade glassware.

PERSONAL

MR. R. H. COOKE, of Phillips Electrical, Ltd., has been appointed assistant manager of its X-ray department. For the past four years he has maintained close contact with universities engaged in nuclear physics research, and conducted much of the Philips Company's liaison with AERE, Harwell.

MR. R. L. FORTESCUE has been appointed senior lecturer in charge of the particle accelerator laboratory which is under construction at Queen Mary College, London. This is designed for the study of machines used in nuclear physics and radiotherapy and the principles relating to the use of nuclear energy. Since 1945 Mr. Fortescue has been working at the Atomic Energy Research Establishment, Harwell, as a principal scientific officer.

MR. PHILIP A. SINGLETON, assistant director of Monsanto Chemical Company's foreign department, St. Louis, Mo., U.S.A., is to join the British company on October 9 to assist in representing the organisation's U.K. and European interests.

J. P. FRIEND, from Massachusetts Institute of Technology, is one of two Americans at present taking a vacation course at the Dunlop Research Centre under the International Student Exchange Scheme. He is attached to the chemical research division to study the chemistry of synthetic rubbers.

Obituary

The death is announced, at the age of 68, of MR. ARTHUR JAMES GILLIAN, general secretary of the Chemical Workers' Union for more than 20 years until 1947.

New U.S. Chromium Process

A NEW process will be utilised in an electrolytic chromium plant to be constructed at Sault Ste. Marie, Michigan, by the Electro Metallurgical Division of the Union Carbide & Carbon Corporation, New York. The plant is expected to be in operation by the spring of next year, and will adjoin the company's present facilities used for the production of calcium carbide. The metal produced by the process is claimed to be of a higher degree of purity than any commercially produced chromium metal at present available.

• HOME •

New Iron and Steel Order

The maximum prices of a limited range of iron and steel products have been amended by an order which came into force last Tuesday (August 29). The principal alterations are increases in the maximum prices of electrical sheets, wire and wire products.

Microscope Linked with Television

A method of combining a microscope with a television camera was demonstrated last week to members of the International Institute of Haematology attending their annual conference at Cambridge. Slides of blood samples were reproduced, greatly enlarged, in full colour on a series of television screens.

OCCA Post Graduate Lectures

Post graduate lectures of the Oil and Colour Chemists' Association have normally been held in London, but this year the tenth series is being organised by the Manchester section and will take place at Cheetham Town Hall on Fridays September 29, October 6 and 13 at 6.30 p.m. The subject is "Topics in Colloid Science," and the lecturer A. S. C. Lawrence, Sc.D., Ph.D., F.R.I.C.

Midlands Gas Price Increases

Increases in the price of gas in most parts of Warwickshire, Worcestershire, Staffordshire, Herefordshire and Shropshire are announced. The increased charges vary between $\frac{1}{2}d.$ a therm, for most districts where gas is sold on a thermal basis, and 3d. per 1000 cu. ft. for most areas where it is sold by volume. The increases are stated to be due to higher transport charges and wages, and a rise in the cost of gas oil.

Education in the Electroplating Industry

A special joint meeting of the Electrodepositors' Technical Society and the Metal Finishing Association will be held at the James Watt Institute, Great Charles Street, Birmingham, next Tuesday. An address on "Education in the Electroplating Industry" will be given by Mr. C. Harris, chairman of the Midlands Centre. A joint discussion will follow, with special reference to implementing the new Fellowship in Electrometallurgy at Birmingham University and to framing a constructive resolution on education in the plating trade, both from the technical school and apprenticeship standpoint.

Electrodepositors Going to Holland

A joint meeting of the Electrodepositors' Technical Society with the Dutch Electroplaters' Society (*Studiekring Galvanotechniek*) will take place in Holland at The Hague (Scheveningen) and Eindhoven from Wednesday September 27 to Saturday September 30.

Control of Tin Planned

An international tin conference is being arranged to take place next month at the headquarters of the United Nations in Geneva. More than 50 countries and international organisations are expected to attend and a draft agreement, prepared by the International Tin Study Group, for control of the commodity will be studied.

High Vacuum Research

British-American Research, Ltd., which manufactures high vacuum equipment, has left its Hillington, Glasgow factory and is now located at Wishaw. It is planning an expansion of research and development work in the applications of high vacuum plant in co-operation with a number of industrial concerns interested in the field and its uses.

Uranium in North Wales

A find of relatively high radioactivity in the Dolgelley black band shales of North Wales was announced at the beginning of this week by the Department of Scientific and Industrial Research. Deposits were found by the Geological Survey and some 4000 samples have been examined and analysed. It is estimated that there may be a million tons of uranium in submarginal grade rocks carrying 80 grams a ton. The normal minimum economic grade considered worth exploitation, has up to now, been at least 150 grams.

£4 m. Steel Project

Extensions planned by Colvilles, Ltd., at its Clydebridge works, Cambuslang, are expected to be completed next month. It is intended to develop steel-making by the hot metal process using liquid iron and in conjunction with the two additional 300-ton tilting furnaces to take liquid pig iron from the nearby Clyde iron works. The total scheme estimated at over £4 million incorporates a battery of new soaking pits, stripper and slab handling bays and duplication of the 68-oven battery at Clyde iron works to ensure coke self-sufficiency.

The Stock and Chemical Markets

MARKETS were influenced earlier this week by the caution on the part of buyers reflecting conflicting views as to China's intentions in the Far East. After their recent strength, British Funds turned reactionary with 3½ per cent War Loan back to 94½. Nevertheless, there was little selling, but the trend in gilt-edged stocks governed other sections, and generally small declines prevailed, although the engineering and armament sections held recent gains.

In some cases, however, because of the reduced demand in evidence, moderate selling had a disproportionate effect on prices. Imperial Chemical, for instance, have fallen sharply to 41s. 10½d. at the time of writing, Monsanto were steady at 49s. 6d., Fisons were 26s. 6d. and Laporte Chemicals 5s. units 10s. 4½d. Albright & Wilson 5s. shares strengthened from 30s. 6d. to 30s. 9d. on the surprise announcement by the directors foreshadowing a share bonus of 100 per cent by the end of the year. Meanwhile, the issue of over £2 million of 5 per cent preference shares at 20s. each on the basis of one for every two 5s. ordinary held is expected to be a big success. The directors believe that profits are unlikely to be below last year's £912,735, on which basis the preference dividend would be covered seven times.

Brotherton 10s. shares have remained at 19s. 10½d., W. J. Bush were 81s. 9d., Lawes Chemical 10s. 3d., and F. W. Berk 2s. 6d. shares have strengthened to 10s. 6d. Boake Roberts 5s. shares were 29s. 9d. and Amber Chemical 2s. shares 3s. Pest Control were 6s. 9d., Bowman Chemical 4s. shares 5s. 8d., L. B. Holliday 4½ per cent preference 19s. 6d., and British Chemical & Biologicals 4 per cent preference 17s. 3d. Woolley 4½ per cent debentures remained at 104½.

Glaxo Laboratories showed firmness at 48s. 3d., Turner & Newall were steady at 80s. 3d. on talk of higher dividend prospects, and Borax Consolidated kept at 54s. 6d. United Molasses at 42s. 9d. were little changed on balance, and the 4s units of the Distillers Co. moved up to 19s. 3d. on further consideration of the annual report, which tended to emphasise the widespread chemical and industrial interests of the group.

Associated Cement at 85s. held up quite well, British Plaster Board 5s. ordinary were 14s. 1½d., and paint shares were mostly firm, Pinchin Johnson at 40s. 3d. having remained under the influence of

the chairman's statement foreshadowing segregation of the company's overseas assets. United Glass Bottle were again 75s., and Triplex Glass 10s. shares firmed up to 24s. 6d.

In iron and steels, Hadfields eased to 28s., but Dorman Long at 32s. 1½d. and United Steel at 28s. 1½d. held up well.

Boots Drug at 49s. lost an earlier rise, Griffiths Hughes were 20s. 9d. and Beechams deferred 12s. 9d. Plastics kept around last week's levels, although British Xylonite eased to 72s. 6d. British Industrial Plastics 2s. shares were 5s. 6d., De La Rue 23s. 6d. and Kleemann 7s. 7½d. Lever & Unilever again changed hands around 39s. 9d., British Match were 34s. 3d. and British Aluminium firmed up to 41s. 6d. Oils turned reactionary with the general trend of markets earlier in the week. Anglo-Iranian eased to 5 13/16, Shell were 62s. 6d. and Burmah Oil 55s.

Market Reports

THE past week has witnessed a steady demand for the general run of industrial chemicals and the renewed interest in contract business has been fairly well sustained. There has been a steady overseas inquiry and actual bookings are reported to cover good volumes. The price position remains firm with no alterations of importance on the week, and although conditions continue active the market is without feature. There is a ready outlet for most of the coal tar products and quotations are steady with a strong under-tone.

MANCHESTER.—Firm price conditions obtained in most sections of the Manchester chemical market, though actual changes compared with a week ago having been few. Home trade consumers of the bread-and-butter lines are calling for steady deliveries under contracts, and a fair aggregate weight of business has been placed in the alkalis and many other heavy chemicals. Most of the potash compounds are finding a ready outlet. A fair export trade is passing and additional inquiries covering a fairly wide range has been reported during the week. Most of the tar by-products are meeting with a reasonably steady demand.

GLASGOW.—The Scottish heavy chemicals market continues to improve and orders are arriving with steady regularity. Exports have improved in volume considerably during the past week.

Law and Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

COMPRESSED RUBBER PRODUCTS, LTD., Harefield. (M., 2/9/50). July 24, £1600 charge, to Miss E. A. Warren, London; charged on 6 Beechcroft Avenue, Croxley Green. *—September 3, 1947.

ELCO PLASTICS, LTD., London, E.C. (M., 2/9/50). July 27. £4000 deb., to A. S. Levinger, London; general charge. *Nil. Dec. 31, 1949.

EXPANDED ALUMINIUM PRODUCTS (READING), LTD., London, E.C. (M., 2/9/50). July 28, series of £2000 debts. present issue £1200; general charge.

GREENS FOUNDRIES (PETERBOROUGH), LTD. (formerly **GREENS ALUMINIUM FOUNDRIES, LTD.**). (M., 2/9/50). July 27, £600 mort., to Nottingham Building Soc.; charged on 50 Alma Road, Millfield, Peterborough. *Nil. Apr. 25, 1949.

MELWOOD THERMOPLASTICS, LTD., London, E.C. (M., 2/9/50). July 26, £10,000 debts.; general charge. *£3000. Dec. 26, 1949.

Satisfactions

W. EDMONDS & CO., LTD., London, W., chemists. (M.S., 2/9/50). Satisfaction July 29, of debts. reg. May 20, 1930, to the extent of £4000.

MERRIGLO, LTD. (formerly **MERRIGLO (PLASTICS), LTD.**), London, W., dealers in plastic materials, etc. (M.S., 2/9/50). Satisfaction July 31, of deb. reg. Oct. 8, 1948.

JAMES VINCE & CO., LTD., Battersea, electro platers, etc. (M.S., 2/9/50). Satisfaction July 28, of debts. reg. Aug. 21, 1930, to the extent of £1900.

Change of Name

The name of Henley Industries, Ltd., has been changed to **HENLEYS MEDICAL SUPPLIES, LTD.**

Increases of Capital

The following increases of capital have been announced: **Deodor-X Company of England, Ltd.**, from £100 to £30,000; **Deodor-X Hygiene Services, Ltd.**, from £100 to £10,000; **Wm. Lindlatten & Co., Ltd.**, from £2000 to £6000.

New Registrations

Barrymoors, Ltd.

Private company. (485,432). Capital £1000. Manufacturers of minerals, oils, ores, metals, chemicals, etc. Directors: J. H. Davies, "Hillside," Danycoed Road, Cyncoed, Cardiff; and J. L. Walters, Tudor House, Llyswen Road, Cyncoed, Cardiff. Reg. office: Barrymoors, Cadoxton, Barry, Glam.

Breaks Brothers, Ltd.

Private company. (485,435). Capital £10,000. Manufacturing, pharmaceutical, analytical and advising chemists; manufacturers of solvents, etc. Directors: J. J. Breaks, 290 Rooley Lane, Bradford; J. R. Breaks, 570 Heaton Road, Bradford; and J. Dyson, 43 Thorn Lane, Haworth Road, Bradford. Reg. office: Powell Road, Bolton Woods, Bradford.

Certofix, Ltd.

Private company. (485,266). Capital £100. Manufacturers of all kinds of chemical substances, including cements, glues, mastics, resins and other adhesives, etc. Company secretary: J. Green, 92 Hardy Street, Hull.

Dietetic Preparations, Ltd.

Private company. (485,089). Capital £100. Cleaning and sterilising, manufacturers of vegetable and mineral drugs, alkaloids, etc. Directors: J. Webster, Carlton Mill, Clitheroe, Lancs., and J. A. Rush.

Fibre Form, Ltd.

Private company. (485,236). Capital £100. Moulders and/or turners of plastic materials of all kinds, substances and compositions, chemicals and chemical products, etc. Directors: B. Gardner and O. A. W. Budd. Reg. office: 39 New Broad Street, E.C.

Gamlen (London) Ltd.

Private company. (485,561). Capital £10,000. Manufacturers and exporters of chemicals and chemical products, etc. Subscribers (each with one share): B. S. Fisher and S. Disborough, both solicitors, of 18, Austin Friars, E.C. Reg. office: 11 Ironmongers Lane, E.C.2.

Patent Processes in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted will be obtainable, as soon as printing arrangements permit, from the Patents Office, Southampton Buildings, London, W.C.2, at 2s. each. Higher priced photostat copies are generally available.

Complete Specifications Accepted

Insecticidal compositions.—Merck Co., Inc. Aug. 21 1946. 643,450.

Methods of conditioning and treating lime and product thereof.—G. & W. H. Corson, Inc., and B. L. Corson. Sept. 17 1946. 643,451.

Liming of skins and hides.—S. Payne. Jan. 15 1947. 643,452.

Methods of manufacturing mouldings of synthetic resin material suitable for high-tension insulation.—Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Oct. 17 1946. 643,453.

Methods for purifying town gas.—L. Fassina, and L. Fassina. Oct. 22 1946. 643,454.

Surface active ingredients.—Sharples Chemicals, Inc. Nov. 13 1946. 643,456.

Process for waterproofing materials and the waterproofed materials so produced.—F. J. Sowa. Nov. 22 1946. 643,458.

Coating compositions.—A. McDonald. Dec. 4 1946. 643,512.

Glass-to-metal seals.—British Thomson-Houston Co., Ltd., and W. J. Scott. June 11 1948. 643,523.

Catalysts.—Anglo-Iranian Oil Co., Ltd., E. W. M. Fawcett, and J. N. Haresnape. Jan. 22 1948. 643,459.

Methods of producing penicillins.—E. Lilly & Co. Jan. 15 1947. 643,514.

Printing of polyvinyl resins.—Associated Technical Manufactures, Ltd., L. W. E. Townsend, and E. C. Bate. Jan. 14 1948. 643,463.

Process for vapour phase hydrogenation of the saturated compounds.—Koppers Co., Inc. April 1 1947. 643,326.

Method of and apparatus for forwarding filamentary material.—Imperial Chemical Industries, Ltd., and A. Nield. April 14 1948. 643,516.

Aryl-substituted alkanes.—California Research Corporation. April 16 1947. 643,517.

Manufacture of proteolysed liver preparations.—Raptakos, Brett & Co., Ltd., and G. B. Ramasarma. May 20 1947. 643,331.

Manufacture of acetic acid and other oxygen-containing aliphatic compounds.—J. G. N. Drewitt. June 11 1948. 643,468.

Method for making phosphonic acids or derivatives of phosphonic acids, and products thereof.—W. W. Triggs (Oldbury Electrochemical Co.). June 19 1947. 643,334.

Calcining lime bearing sludges.—Dorr Co. July 4 1947. 643,335.

Amino-alkyl derivatives of thiophenes.—Socony-Vacuum Oil Co., Inc. July 29 1947. 643,337.

Method of manufacturing sulphurous anhydride.—J. C. Seailles. July 29 1947. 643,479.

Insecticidal compositions.—Harvel Corporation. July 30 1947. 643,480.

Automatic gas safety shut-off.—R. E. Newell. July 30 1947. 643,482.

Petroleum oils and greases made there-with.—Harvel Corporation. Aug. 7 1947. 643,489.

Physiologically active substances.—Sharp and Dohme, Inc. Aug. 7 1947. 643,382.

Heat repellent paints, cements, and the like.—G. S. Adlington. Aug. 16 1948. 643,345.

Plastic composition.—Hercules Powder Co. Aug. 27 1947. 643,348.

Manufacture of soaps.—R. J. B. Elissabide. Aug. 27 1947. 643,498.

Formation of metallic films by thermal evaporation.—Polytechnic Institute of Brooklyn. Sept. 12 1947. 643,494.

Processes for the preparation of products smelling of iron.—processes for preparing 6-methyl- α -ionone and -methyl- β -ionone and products smelling of iron.—H. Firmenich, A. Firmenich, R. Firmenich, and G. Firmenich (trading as Firmenich & Co.). Sept. 19 1947. 643,353.

Manufacture of monoazo-dyestuffs.—Ciba, Ltd. Sept. 25 1947. 643,354.

Heating of containers receiving material intended to be extruded under pressure.—Soc. Anon. Des Ateliers et Chantiers de la Loire, and Compagnie Generale du Duralumin et du Cuivre. Oct. 1 1947. 643,357.

Electrostatic dust precipitation.—Westinghouse Electric International Co. Oct. 14 1947. 643,363.

Concentration of the carotenoid content of a fatty oil.—M. W. Kellogg Co. Oct. 16 1947. 643,365.

Horticultural compositions.—B. F. Goodrich Co. Oct. 17 1947. 643,519.

Thermal treatment of steel and products thereof.—Uddeholms Aktiebolag, and A. G. Molinder. Nov. 30 1948. 643,367.

Process for the production of oxygen-containing hydrocarbon derivatives.—J. G. Fife. (Naamlooze Vennootschap de Bataafse Petroleum Maatschappij). Nov. 3 1947. 643,503.

Process for making valuable products out of metallurgical slags.—J. C. Seailles. Nov. 5 1946. 643,849.

Methods of separating mixed fatty acids.—Emery Industries, Inc. Nov. 28 1946. 643,851.

Production of soap.—J. K. O. H. Holmberg. Dec. 11 1946. 643,852.

Medicinal capsules and process of manufacture.—E. Lilly & Co. Jan. 3 1947. 643,853.

Method and apparatus for moulding articles from plastic materials.—Gora-Lee Corporation. Jan. 9 1947. 643,855.

Process for preshrinking fabrics.—F. R. Redman. Feb. 19 1947. 643,714.

Refining of silver alloys.—B. K. Bose and G. C. Mitter. May 27 1947. 643,667.

Recovery of metals from base metal nitrates.—B. K. Bose and G. C. Mitter. June 4 1947. 643,668.

Collagen strands and the manufacture thereof.—American Cyanamid Co. April 10 1947. 643,859.

Impregnated paper.—Plywoods-Plastics Corporation. April 24 1947. 643,782.

Insecticides.—Mathieson Alkali Works. May 19 1947. 643,676.

Methods of oxidation of hydrocarbons and the products resulting therefrom.—Clark Bros. Co., Inc. May 29 1947. 643,862.

Sprayed metal protective coatings for metal or other base members.—Westinghouse Electric International Co. June 6 1947. 643,678.

Coating and decorating compositions.—Interchemical Corporation. July 16 1947. 643,724.

Ammonium nitrate blasting cartridges.—Atlas Powder Co. July 21 1947. 643,871.

Ammonium nitrate-containing blasting cartridges.—Atlas Powder Co. July 21 1947. 643,872.

Production of hydroxy benzene resins and product thereof.—Koppers Co., Inc. Aug. 6 1947. 643,730.

Surface treatment of magnesium alloys.—A. Abbey (Dow Chemical Co.). Aug. 15 1947. 643,877.

Production of acid chlorides of aromatic polybasic acids.—Wingfoot Corporation. Aug. 27 1947. 643,788.

Process and means for carrying out heat-exchange.—Union des Verrieres Mécaniques Belges Soc. Anon. Sept. 23 1947. 643,881.

Preparation of catalysts containing mercury and their use in the preparation of vinyl halides.—Gevaert Photo-Producten N. V. Oct. 1 1947. 643,743.

Cooling processes and machines.—Petrocarb Ltd., and M. Ruhemann. Oct. 15 1948. 643,886.

Container for penicillin or other viscous

injectable substances.—A. M. Bickford & Sons, Ltd. Oct. 30 1947. 643,887.

Dyes and pigments derived from thiazoyl-2 thioglycolic acids.—Ilford, Ltd., G. F. Duffin and J. D. Kendall. Nov. 9 1948. 643,681.

Method of and apparatus for continuous extraction from solid materials.—Prvni Brnenska A. Kralovopolska Strojirna Gottwaldovy Zavody, Narodni Podnik. Nov. 19 1947. 643,893.

Thermosetting moulding compositions.—British Industrial Plastics, Ltd. Nov. 20 1947. 643,750.

Clear, smooth-surfaced bubble-free castings of a polymerised vinylidene compound and method of producing same. Nov. 24 1947. 643,752.

Heat-exchange devices.—Imperial Chemical Industries, Ltd., and A. G. Butt. Dec. 10 1948. 643,688.

Granulation of super-phosphatic fertilisers.—Sturtevant Engineering Co., Ltd., H. Richardson & Co. (York), Ltd., J. T. Procter and A. Ogilvie. Oct. 15 1948. 643,762.

Devices for mixing disinfectant or other liquids with water.—Non-Drip Measure Co., Ltd., and W. R. Berwick. Feb. 9 1949. 643,763.

Emulsions of saturated fatty acids.—Nopco Chemical Co. Jan. 20 1948. 643,765.

Production of propylene oxide.—Linde Air Products, Co. Jan. 24 1948. 643,687.

Reaction of organic mercaptans with formaldehyde and ammonia.—Monsanto Chemical Co. Jan. 27 1948. 643,688.

Metallurgical apparatus.—Birlec, Ltd. Feb. 28 1948. 643,800.

Process of softening water and a filter for carrying out the said process.—C. H. V. Pape. March 5 1948. 643,805.

Low temperature carbonisation of carbonaceous materials.—M. Steinschlager. March 3 1949. 643,916.

Process of preparing a vitamin preparation and the product resulting therefrom.—E. Lilly & Co. March 23 1948. 643,690.

Feed heating and feed distribution in water tube boilers.—La Mont International Association, Ltd., and F. W. Bower. March 31 1948. 643,813.

Electric insulators having semi-conducting glazes.—Bullers, Ltd., and G. Perrins. May 5 1949. 643,814.

Welding of seams in metallic tubing and between metallic parts.—General Electric Co., Ltd., W. F. Baker, and J. R. Spencer. April 1 1949. 643,816.

Process for coating surfaces.—Schori Metallising Process, Ltd., and P. G. Clements. March 16 1949. 643,691.

Electrodeposition of tin.—W. W. Triggs (Carnegie-Illinois Steel Corporation). May 12 1948. 643,928.

Apparatus for washing suspended matter from air.—Peters-Dalton, Inc. Nov. 5 1947. 643,504.

Diazotype photographic material.—General Aniline & Film Corporation. Dec. 1 1947. 643,375.

Process for the preparation of artificial cryolite substantially free from silica.—Montecatini Soc. Generale Per L'Industria Mineraria e Chimica. Dec. 10 1947. 643,510.

Process for the preparation of aluminium fluoride from fluosilicic acid.—Montecatini Soc. Generale Per L'Industria Mineraria e Chimica. Dec. 15 1947. 643,379.

Production of polymeric materials.—Gas Light & Coke Co., R. H. Griffith, and J. H. G. Plant. Dec. 16 1948. 643,388.

Process and apparatus for the production of polymeric materials.—Soc. Belge de L'Azote et des Produits Chimiques du Marly. Dec. 30 1947. 643,527.

High-efficiency combustion of solid fuel.—Spladis Soc. Pour L'Application D'Inventions Scientifiques. Dec. 31 1947. 643,393.

Apparatus and a process for the manufacture of sulphuric acid.—P. Guareschi, G. Maragliano-Bussetti, and L. Pettenati. Dec. 31 1947. 643,394.

Process for the recovery of pectic products from vegetable matter.—A.S.P. Chemical Co., Ltd., C. L. Walsh, B. A. Adams, and J. P. Cook. Dec. 18 1948. 643,533.

Apparatus for identifying colour.—D. W. Thomasson. Dec. 29 1948. 643,396.

Process for coating metal objects by electrophoresis.—Soc. Anon. de Commentry Four-Chambault & Decazeville. Jan. 7 1948. 643,534.

Manufacture of tetrakisazo-dyestuffs.—Ciba, Ltd. Jan. 8 1948. 643,535.

Lubricating compositions.—Standard Oil Development Co. Jan. 9 1948. 643,536.

Method of forming coated surfaces.—Schori Metallising Process, Ltd., and P. G. Clements. Jan. 31 1949. 643,539.

Production of blown fatty materials.—Nopco Chemical Co. Feb. 12 1948. 643,403.

Agglutinogen derived from whooping cough organisms.—E. W. Flosdorff. Feb. 24 1948. 643,546.

Power plant in which a vapour is used to heat a gaseous working fluid.—C. W. Kay. Oct. 4 1948. 643,598.

Photographic developers.—E. I. Du Pont de Nemours & Co. March 4 1948. 643,411.

Hydrocarbon synthesis.—Standard Oil Development Co. April 1 1948. 643,606.

Purification of oxo-alcohols and esters thereof.—Naamlooze Venootschap de Bataafsche Petroleum Maatschappij. April 9 1948. 643,610.

Processing of wool wax alcohols and products derived therefrom.—Fulmer Research Institute, Ltd., and E. S. Lower. April 4 1949. 643,422.

Production of acetic anhydride.—Courtaulds, Ltd., P. K. Williamson, and D. L. Tyler. June 1 1949. 643,620.

Resistance welding apparatus.—Mallory Metallurgical Products, Ltd. June 8 1948. 643,622.

Process for the manufacture of salts of D-tubocurarine and its alkyl and aryl ethers.—Allen & Hanburys, Ltd., and C. J. Eastland. March 4 1949. 643,425.

Incandescent mantles for lighting and heating appliances.—Tilley Lamp Co., Ltd., and W. G. Colle. May 23 1949. 643,638.

Process for the absorption of carbon monoxide.—Power-Gas Corporation, Ltd., and L. Kryszkowski. Aug. 26 1949. 643,431.

Liners for cylinders.—Norton Co. Nov. 3 1948. 643,435.

Process for the refining of glass.—Soc. Anon. Des Manufactures Des Glaces Et Produits Chimiques De St.-Gobain, Chauny, & Cirey. Jan. 12 1949. 643,488.

Construction of gun for spraying heat-fusible materials.—Metallizing Engineering Co., Inc. July 7 1949. 643,569.

Process for producing shaped products from thermosetting synthetic resins.—Dunlop Rubber Co., Ltd., W. H. Chapman and M. Goldstaub. April 19 1947. 643,845.

Refractory or abrasive materials and methods for their manufacture.—Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny & Cirey. Aug. 27 1946. 643,653.

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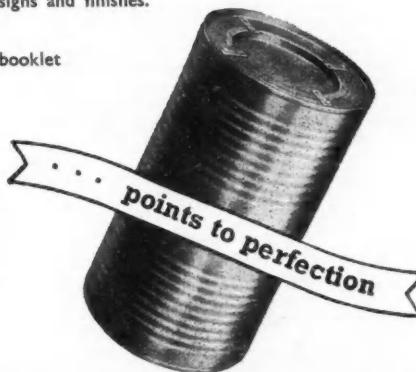
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Protection for the Porcupine certainly has its points—but these long sharp quills are a means of attack as well as defence. They are longer and thicker on the tail and hindquarters, so when necessary he raises them and charges backwards. Unorthodox maybe—but very effective.

Where chemicals are concerned, however, other important points of protection are given by Todd Drums and Kegs. Strong, long-lasting, firmly clamped, they can be supplied Galvanised, Lead-coated or in a variety of designs and finishes.

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CLASSIFIED ADVERTISEMENTS

EDUCATIONAL

UNIVERSITY OF MANCHESTER

The next session commences on Thursday, 5th October, 1950.

SITUATIONS VACANT

ASSISTANT CHEMIST required by a Persian Gulf Oil Company for general chemical supervision of refinery operations including distillation, blending, plumbite treating and related duties. Must possess B.Sc.(Chem.) and have experience of testing petroleum and allied products. Age under 30, salary according to age and experience, but not less than starting £750 p.a. tax free. Messing and accommodation free, kit allowance. Write, giving details age and experience to **BCX "G.T."**, c/o J. W. Vickers & Co., Ltd., 7/8 Great Winchester Street, London, E.C.2.

EXPERIENCED ENGINEER, with Degree standard in Mechanical, Heating or Chemical Engineering, required as Technical Assistant by leading Chemical Engineering Firm for design and calculations on heat transfer problems and also preparation of tenders, commissioning of plant and technical sales. Previous experience and proven ability in similar work essential. This is a permanent and progressive appointment. Residence in London area necessary. Write, stating age, experience and salary expected, to Box No. CA 2939, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

NORTH THAMES GAS BOARD.

LABORATORY ASSISTANTS

LABORATORY ASSISTANTS, 21 to 25 years of age, are required in the Board's Laboratories at **ASCOT** and **HIGH WYCOMBE**, in the Provincial Area, and at **LEA BRIDGE, HORSEY, POPLAR, ROMFORD, BECKTON** and **FULHAM**, in the Metropolitan Area. Candidates should have matriculated or obtain d exemption therefrom, or hold Inter-B.Sc. qualification.

The starting salary range is from £265 per annum to £325 per annum in the Provincial Area, and from £295 p.a. to £355 per annum in the Metropolitan Area, paid on a weekly basis according to age, qualifications and experience.

Applications, stating age, and giving full particulars, should be addressed to the **Staff Controller, North Thames Gas Board, 30, Kensington Church Street, London, W.8**, quoting Reference Number 9854.

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UNUSED JAC. VACUUM or DRYING OVENS, 8 ft. by 5 ft., 7 ft. by 4 ft. and 7 ft. by 3 ft. diam. Unused **CONDENSERS**, 3½ ft. by 5 in. diam., 325-½ in. diam. copper tubes.

W.S. JAC. ENC. VERT. MIXER, 4 ft. by 4 ft. diam. **MICRO-TWIN LAB. REFINER, W.C.** Rolls, 9 in. by 6 in. by 4½ in.

B.P. JAC. TWIN-BLADE TIPPING ELEC. MIXERS, 28 in. by 28 in. by 30 in., 400/3/50. **HARRY H. GARDAM & CO., LTD.**, STAINES.

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VARIOUS MIXERS FOR SALE

BAND CONVEYOR, 50 ft. long 40 in. wide, steel frame, motorised, for boxes, cases, bags, etc.

A FILTER PRESS, 31½ in. square, fitted with 42 C.I. plates, centre fed.

FILTER PRESS, 25 in. square, fitted with 24 plates, cast iron built and steam heated.

Four GARDNER HORIZONTAL MIXERS, for powders, from 100 lbs. to 250 lbs. capacity, all motorised, three with Radicon Reduction Gear Boxes and one with a Spur Gear Drive.

Two large unjacketed WERNER MIXERS, belt and gear driven, hand tipping, double "Z" arms, pans 53 in. by 45 in. by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCORPORATOR**. Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the top of the tipping screw.

No. 204 One **WERNER PFLEIDERER MIXER OR INCORPORATOR**, similar to the above, with a C.I. built pan 25 in. by 25 in. by 19 in. deep, belt pulleys 26 in. diam. by 5 in. face, double fin-type agitators, and mounted on C.I. legs.

No. 208 One **DITTO** by **WERNER PFLEIDERER**, with a C.I. built pan or mixing chamber, of the double "U" type, 4 ft. 5 in. long by 3 ft. 8 in. by 33 in. deep, with double "Z" mixing arms, gears at each end, hand-operated tilting gear, with steel backframe, counterbalancing weights and chains, and fast and loose pulleys 3 ft. diam. by 6 in. face.

No. 209 One **HORIZONTAL "U"-SHAPED MIXER**, steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

No. 210 One **HORIZONTAL MIXER** as above.

No. 211 One **HORIZONTAL MIXER** as above.

These three "U"-shaped mixers are in some cases fitted with steel plate covers and a steam jacket round the bottom and extending to within about 18 in. of the top with plain end plates.

Further details and prices upon application.

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TWO EVAPORATING AND DISTILLING PLANTS by **G. & J. WEIR**, new 1945, cap. 100 tons each, fresh water in 24 hours. Evaporators 6 ft. 9 in. high by 30 in. diam. 10 banks copper steam coils secured in C.I. header easily removed by opening inspection doors (spare coils available). Each unit complete with distiller condenser 2 ft. diam., by 4 ft. 10 in. Cooler condenser, 9 in. diam. by 4 ft. 10 in. One evaporating reciprocating steam-driven combination pump dealing with feed discharge and vacuum, and one steam-driven reciprocating circulating water pump. Interconnecting piping not included.

DRYING INSTALLATION by **MARLOWE-ALLIOTT** of Nottingham, comprising rotary drier, 60 ft. long by 8 ft. diam. constructed in plate, two roller paths, drive on to main girth gear through open reduction gear. Dennis unit patent travelling grate stoker 434 sq. ft. grate area for the furnace at feed end, also dust extraction plant by Sturtevant, comprising 32 in. steel case fan and two 11 ft. diam. cyclone dust collectors.

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TRough MIXER/DRYER by **SIMON**, horiz. int. dimensions 8 ft. by 2 ft. 6 in. deep by 2 ft. 8 in. wide. Agitator comprises bank of 16 solid drawn tubes approx. 6 ft. 6 in. long by 24 in. o.d. Chain and sprocket drive 8 in. spare bottom side discharge.

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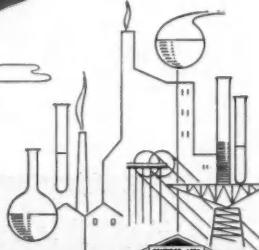
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